Tamworth BESS

EIS Noise and Vibration Assessment

S210219RP1 Revision I

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Resonate

Document Information

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Revision Table

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A	18 November 2021	Final	Raymond Sim	Andrew Parker
B	19 November 2021	Final – minor changes	Raymond Sim	Andrew Parker
C	24 February 2022	Final – remove mitigation options	Raymond Sim	Andrew Parker
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G	29 February 2024	Final address comments	Raymond Sim	Andrew Parker
H	26 March 2024	Address minor typos	Raymond Sim	Andrew Parker
I	21 May 2024	Updated sound data of battery enclosures	Raymond Sim	Andrew Parker

Glossary

BESS	Battery Energy Storage System
EPA	Environment Protection Authority
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline
NML	Noise Management Level
NPI	Noise Policy for Industry
NSW	New South Wales
OOHW	Out-of-Hours Work
PPV	Peak Particle Velocity
Project Area	Refers to the BESS site, substation and electrical transmission line
RBL	The RBL is the overall single figure background level representing each assessment period (day, evening and night) over the whole monitoring period (as opposed to over each 24-hour period used for the ABL). This is the level used for assessment purposes. It is the median value of: • All the day assessment background levels over the monitoring period for the day; • All the evening assessment background levels over the monitoring period for the evening; or • All the night assessment background levels over the monitoring period for the night.
RNP	Road Noise Policy
SPL	Sound Pressure Level
SWL	Sound Power Level
TfNSW	Transport for NSW
VC	Generic Vibration Criterion
VDV	Vibration Dose Values
VML	Vibration Management Level

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1 Introduction

Resonate Consultants Pty Ltd (Resonate) has been engaged by Accent Environmental Pty Ltd (AE) on behalf of Valent Energy Developments Pty Ltd (previously known as GMR Energy or GMR) to prepare a noise and vibration impact assessment for the proposed Tamworth Battery Energy Storage System (the Project).

1.1 Scope and objectives

The purpose of this report is to provide a noise and vibration impact assessment for the Project that addresses the Secretaries Environmental Assessment Requirements for the EIS which includes:

> *Noise – including an assessment of the construction noise impacts of the development in accordance with the Interim Construction Noise Guideline (ICNG), operational noise impacts in accordance with the NSW Noise Policy for Industry (2017), cumulative noise impacts (considering other developments in the area), and a draft noise management plan if the assessment shows construction noise is likely to exceed application criteria.*

The objectives of this study were to:

1) Establish noise level design goals (criteria) for environmental noise emissions at potentially noise affected sensitive receivers surrounding the Project site;
2) Determine all acoustically significant plant required for the construction and operation of the Battery Energy Storage System (BESS) facility to predicted noise at the nearest potentially affected noise sensitive receivers within the vicinity of the Project site; and
3) From results of the noise predictions, assess noise levels from proposed construction and future operations relative to the noise criteria at the nearest potentially affected receivers.

Specific acoustic terminology is used within this report. An explanation of common terms is included in Appendix A.

1.2 Relevant guidelines

The noise and vibration guidelines for construction and operations are based on the publications managed by the New South Wales (NSW) Environment Protection Authority (EPA). The EPA guidelines applicable to this assessment include:

- Construction Noise – *Interim Construction Noise Guideline* (DECC 2009);
- Construction Road Traffic Noise – *Road Noise* Policy (DECCW 2011); and
- Operational Noise – *Noise Policy for Industry* (EPA 2017).

2 Project description

2.1 The project

Valent Energy is proposing to construct and operate a utility-scale battery storage project located 6 km southeast of the township of Tamworth in New South Wales (NSW) (Figure 1 provided by Accent Environmental). The proposed Tamworth Battery Energy Storage System (BESS) (the project) will have a capacity of up to 200 megawatts (MW) or 400 megawatt hours (MWh).

The project will include up to 136 containerisation battery units which make up 68 BESS banks which comprise of 68 power conversion systems (PCS), 34 medium voltage transformers, high voltage transformers, switchgear, and auxiliary equipment. It will also include two switch-rooms, two control rooms and an on-site 33/132 kV substation. The project is a major infrastructure development that is expected to create up to 100 jobs during construction.

The Project is a State Significant Development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011. As a SSD, an application for the Project is required to be submitted under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979*. The NSW Minister for Planning (or the Minister's delegate) is the consent authority.

2.2 Locality

The Project site has been selected due to its proximity to State-significant electrical infrastructure – including the adjacent Tamworth Substation which has capacity to accept up to 200 MW of energy from the BESS – and its low environmental sensitivity and lack of locational constraints.

The Project is in the Tamworth Regional Council Local Government Area (LGA) of north-east New South Wales. The project site is to be located on Lot 44 DP1064582 at 696 Burgmanns Lane, Tamworth, which is approximately 6 km south-east of Tamworth.

There is an existing residential dwelling within the project site, however, this has since been entered into an option to purchase agreement contract, with the intent of purchase for the development of Tamworth BESS. The nearest dwelling has been identified to be 744 Burgmanns Lane, Kingswood, which is located approximately 270 m to the south-east of the nearest BESS facility boundary and adjoins the Project lot boundary to the east. There are 38 receivers (including associated) within 1 km of the site. The site location and nearest receivers are presented in Figure 2.

2.3 Noise sensitive receivers

The closest potentially impacted sensitive receivers identified in the vicinity of the Project area are listed in Table 1 and are shown in Figure 2. Additional residential receivers R34, R35, R36 and R37, which are located at approximately 1 km from the Project area, have recently been identified and have not been considered in the noise assessment. That said, as the additional receivers are furthest from the Project, mitigation measures recommended in Section 6.4 and Section 7.4 would suffice to ensure compliance with the noise criteria at these receivers.

Table 1 Nearest noise sensitive receivers within 1 km from the project site

Receiver ID	Address	Receiver type	Coordinates (MGA 56), metre	
			Easting	Northing
R01	744 Burgmanns Lane, Kingswood	Residential	305055.90	6551588.14
R02	652 Burgmanns Lane, Kingswood	Residential	304297.65	6551883.49
R03	111 Burgess Lane, Calala	Residential	305245.72	6552451.23
R04	633 Burgmanns Lane, Calala	Residential	304347.21	6552437.50
R05	57 Falcon Drive, Calala	Residential	305047.03	6552542.42
R06	59 Falcon Drive, Calala	Residential	305124.01	6552534.21
R07	651 Burgmanns Lane, Calala	Residential	304201.51	6552255.74
R08	51 Falcon Drive, Calala	Residential	304913.39	6552606.44
R09	55 Falcon Drive, Calala	Residential	305015.92	6552610.65
R10	781 Burgmanns Lane, Calala	Residential	305635.87	6552046.02
R11	99 Burgess Lane, Calala	Residential	305286.73	6552546.98
R12	795 Burgmanns Lane, Calala	Residential	305629.19	6551962.27
R13	625 Burgmanns Lane, Calala	Residential	304410.63	6552618.45
R14	66 Falcon Drive, Calala	Residential	305090.60	6552688.83
R15	9 Whipbird Street, Calala	Residential	304713.54	6552731.09
R16	49 Falcon Drive, Calala	Residential	304964.33	6552699.95
R17	94 Burgess Lane, Calala	Residential	305231.56	6552669.56
R18	93 Burgess Lane, Calala	Residential	305312.98	6552614.18
R19	64 Falcon Drive, Calala	Residential	305102.97	6552748.29
R20	47 Falcon Drive, Calala	Residential	305011.84	6552765.68
R21	10 Whipbird Street, Calala	Residential	304636.40	6552787.07
R22	7 Whipbird Street, Calala	Residential	304833.16	6552838.80
R23	87 Burgess Lane, Calala	Residential	305358.13	6552721.69
R24	62 Falcon Drive, Calala	Residential	305117.53	6552817.01
R25	5 Whipbird Street, Calala	Residential	304846.27	6552886.01
R26	45 Falcon Drive, Calala	Residential	305013.18	6552903.87
R27	68 Burgess Lane, Calala	Residential	305312.20	6552852.80
R28	8 Whipbird Street, Calala	Residential	304727.83	6552961.49
R29	3 Whipbird Street, Calala	Residential	304828.95	6552971.22
R30	69 Burgess Lane, Calala	Residential	305390.90	6552802.38
R31	60 Falcon Drive, Calala	Residential	305124.63	6552929.41

Receiver ID	Address	Receiver type	Coordinates (MGA 56), metre	
			Easting	Northing
R32	56 Darrell Road, Calala	Residential	304560.60	6552963.34
R33	6 Whipbird Street, Calala	Residential	304727.39	6553015.69
R34(1)	605 Burgmanns Lane, Calala	Residential	303777	6552249
R35(1)	586 Burgmanns Lane, Kingswood	Residential	303660	6551955
R36(1)	62 Burgess Lane, Calala	Residential	305352	6552940
R37(1)	43 Falcon Drive, Calala	Residential	304931	6553011
Associated(2)	696 Burgmanns Lane, Calala	Residential	304787.90	6551724.30

(1) Additional residential receiver identified in January 2024.

(2) Associated residential receiver.

2.4 Hours of operation

It is proposed that the BESS will operate continuously 24 hours a day, 7 days a week.

2.5 Construction hours

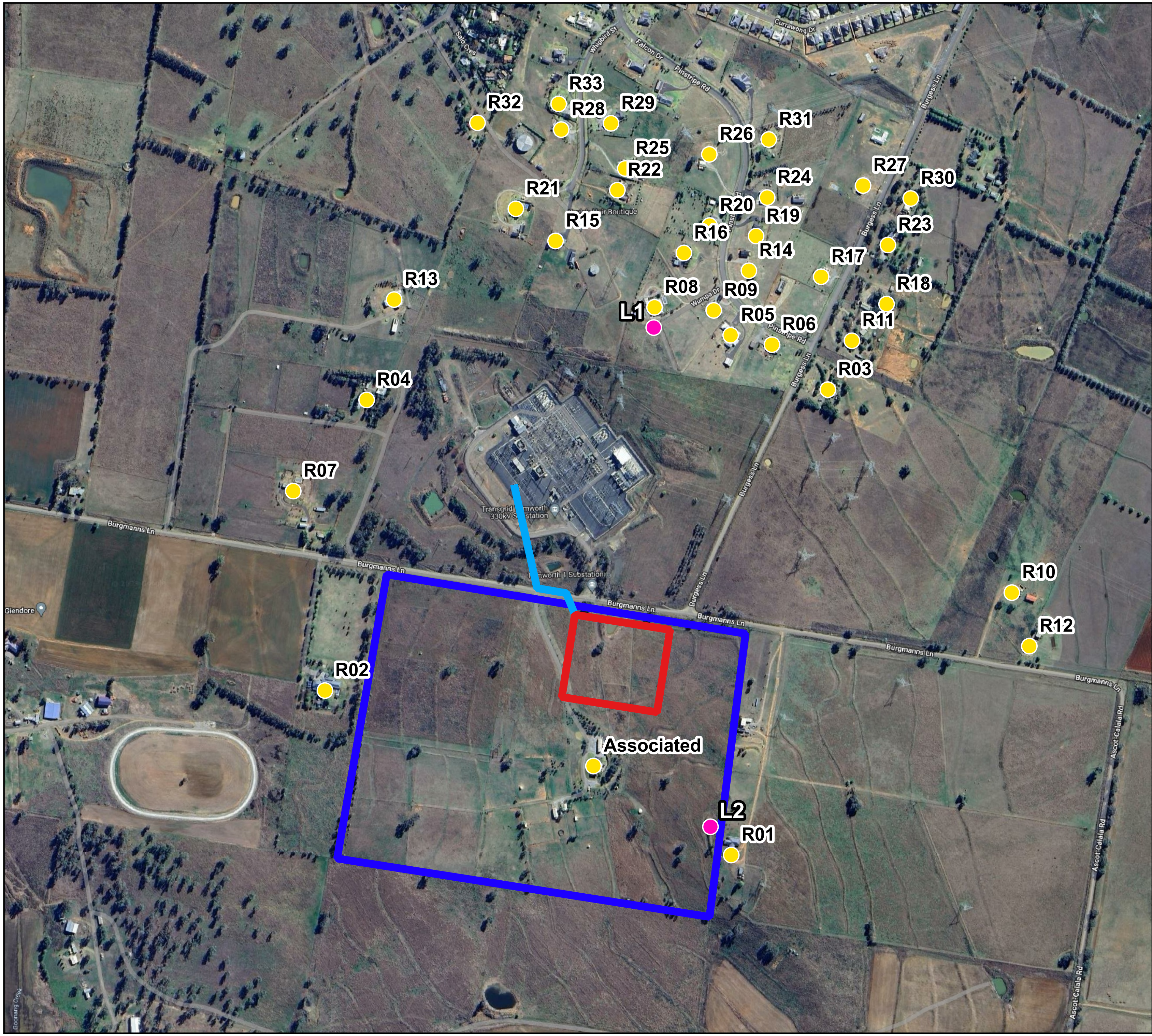
The construction period for the Project is expected to be 24 months. Construction is proposed to occur with the EPA's *Interim Construction Noise Guideline*'s 'standard hours' period. The 'standard hours' period is as follows:

- Monday – Friday: 7 am to 6 pm
- Saturday: 8 am to 1 pm
- No work on Sundays and public holidays.

In general, no construction activities will occur over night, on Sundays or public holidays, however exceptions to these hours may be required on limited occasions, for example:

- The delivery of materials as requested by the NSW Police Force or other authorities for safety reasons and/or to minimise disruption to local traffic;
- Augmentation works to the substation, which may require a temporary power outage, such that the impact on power supplies to the local community is minimised; and
- Emergency work to avoid the loss of life, property and/or material harm to the environment.

The local council, surrounding landholders and other relevant authorities will be notified of any exceptions prior to the works being undertaken.



Tamworth BESS Project

FIGURE 2
Project site location, noise monitoring locations and surrouding receivers

Date: December 2023
Client: GMR Energy Pty Ltd
Prepared by: RS

N

Datum GDA 94, Projection MGA ZONE 56

0 100 200 300 400 500 m

Legend

- Tamworth BESS site
- Transmission line
- Project lot
- Noise logging location
- Receivers

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3 Baseline noise survey

3.1 Unattended noise monitoring

In order to characterise the existing acoustical environment of the area, unattended noise monitoring was conducted between the dates of Thursday 8 June and Friday 23 June 2023 at the logging locations shown in Figure 2. Noise monitoring were conducted at 51 Falcon Drive, Calala (noise logging location L1) which is approximately 550 metres north of the site and at the eastern boundary of the project site adjacent to 744 Burgmanns Lane, Kingswood (noise logging location L2).

The first (L1) and second (L2) noise monitoring locations are considered to be representative of the residential receivers' existing noise environment that are located north and south of Burgmanns Lane respectively.

The logger locations were selected with consideration to other noise sources which may influence readings, security issues for noise monitoring equipment and gaining permission for access from residents and landowners.

The noise loggers provide noise measurements of the baseline background noise environment, which would be used to establish the construction noise management levels and the operational noise criteria.

Instrumentation for the unattended survey comprised of two Rion NL-22 environmental noise loggers (serial numbers: 0841630 installed at L1 and 0862918 installed at L2) fitted with microphone windshield. Calibration of the loggers were checked prior to and following measurements. Drift in calibration did not exceed ±0.5 dB(A). All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

The measured noise data was filtered to remove data affected by inclement weather conditions including precipitation and wind speeds greater than five m/s at an elevation of 1.5 metres. 15-minute weather data from the nearest Bureau of Meteorology (BoM) automatic weather station at Tamworth Airport (055325), located approximately 11 kilometres north-west of the site, were used to perform this filtering. Noting that the wind speed data that was collected at this station is at the standard instrument height of 10 metres, the method outlined in *Converting Bureau of Meteorology Wind Speed Data to local Wind Speeds at 1.5m Above Ground Level,* (Gowan, Karantonis and Rofail, 2004) was used to convert this information to equivalent wind speeds 1.5 metres above ground level. The results were processed into the relevant metrics for assessment. The weather data used in processing the measured noise data has been presented in the noise logger data graphs in Appendix B.

The loggers determine L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10}, L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Acoustic Terminology for definitions in Appendix A). Detailed results at the monitoring location are presented in graphical format in Appendix B. The graphs show measured values of L_{A1}, L_{A10}, L_{A90} and L_{Aeq} for each 15-minute monitoring period.

3.2 Data processing of unattended monitoring results

The noise data obtained from the noise loggers have been processed in accordance with the procedures contained in the NSW EPA's *Noise Policy for Industry* (NPI, 2017) to establish representative noise levels at the monitoring location. The monitored noise levels are detailed in Table 2 below.

Monitoring location L1 would be representative of the cluster of 25 receivers located to the north of Tamworth substation which includes receivers R3, R5, R6, R8, R9, R11, R14 to R32, and monitoring location L2 is considered to be representative of the remainder of the receivers which are R1, R2, R4, R7, R10, R12, R13 and R33.

Table 2 Unattended Noise Monitoring Results

Logger Location	Measurement Descriptor	Measured Noise Level – dB(A) re 20 µPa		
		Day 7:00 am - 6:00 pm	Evening 6:00 pm - 10:00 pm	Night 10:00 pm - 7:00 am
L1	L_{Aeq} (1)	45 (3)	40 (3)	40 (3)
	RBL (L_{A90}) (2)	35 (3) (4)	34 (3)	30 (3) (5)
L2	L_{Aeq} (1)	44 (3)	43 (3)	40 (3)
	RBL (L_{A90}) (2)	35 (3) (4)	34 (3)	30 (3) (5)

(1) L_{Aeq} – Equivalent continuous (energy average) A-weighted sound pressure level. It is defined as the steady sound level that contains the same amount of acoustic energy as the corresponding time-varying sound;

(2) L_{A90} – Noise level present for 90% of time (background level). The average minimum background sound level (in the absence of the source under consideration); and

(3) All values expressed as dB(A) and rounded off to nearest 1 dB(A).

(4) The measured daytime RBL is below the NPI minimum daytime RBL, therefore the daytime RBL has been set to 35 dB(A).

(5) The measured night-time RBL is below the NPI minimum night-time RBL, therefore the night-time RBL has been set to 30 dB(A).

3.3 Site observations

The following observations were made during the setting up and retrieval of the noise loggers:

- The areas surrounding logger L1 are occupied by low density dwellings and the noise environment is influenced by human activities and intermittent road traffic noise on local roads.
- The areas surrounding logger L2 are mostly greenfield/agricultural land use with a small number of residentially dwellings spread across the different lots. The noise environment at logger L2 is mostly influenced by intermittent road traffic noise on Burgmanns Lane.
- Noise from the Tamworth substation was not audible at the noise logger locations during the daytime period when the noise loggers were being set-up or retrieved. However, operational noise from the substation could potentially be audible during the night-time period when the background noise levels are lower.

4 Noise and vibration policies, guidelines and standards

The construction and operational assessments presented in this report have been conducted with due regard to and in general accordance with the following policy, guidelines and standards.

4.1 Secretary's Environmental Assessment Requirements (SEARs)

The Project SEARs require an Environmental Impact Statement to be prepared which addresses the following requirements in relation to noise:

- An assessment of the construction noise impacts of the development in accordance with the *Interim Construction Noise Guideline* and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria
- An assessment of the operational noise impacts in accordance with the *NSW Noise Policy for Industry*
- An assessment of the cumulative noise impacts (considering other operations in the area)

4.2 NSW Interim Construction Noise Guideline

The NSW Department of Environment and Climate Change – *Interim Construction Noise Guideline* (ICNG), presents an accepted method by which construction noise impacts may be assessed for a range of receptor types for works completed in NSW. It provides a set of recommended standard hours of construction, as reproduced below:

- Monday to Friday: 7 am to 6 pm.
- Saturday: 8 am to 1 pm.
- No work on Sundays or public holidays.

The ICNG encourages works to occur within the recommended standard hours of construction unless justification is provided. It focuses on minimising construction noise impacts, rather than only on achieving numeric noise levels, and recognises that some noise from construction sites is inevitable.

The ICNG encourages organisations involved with construction, maintenance or upgrading works (e.g. large scale contractors or Government agencies) to develop their best-practice techniques for managing construction noise and vibration, and implementing feasible and reasonable mitigation measures.

In this case, the ICNG is the suitable guideline document to quantitatively assess potential noise emissions and impacts associated with project construction. The ICNG assessment methodology has been adopted to develop project-specific construction noise management levels (refer Section 5.1), assess potential impacts (refer Section 6) and recommend any necessary mitigation, management measures or provisions for monitoring (refer Section 6).

Table 3 details the construction noise management levels guidance for residential noise sensitive receptors developed in accordance with ICNG. Construction noise management levels for other sensitive receivers are detailed in Table 4.

Table 3 Construction Airborne Noise Management Levels for Residential Receivers

Time of Day	Noise Management Level, $L_{Aeq, 15 minute}$ – dB(A)[1]	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or Public Holidays	Noise affected Rating Background Level (RBL) + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{eq, 15 minute}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be a strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected Rating Background Level (RBL) + 5 dB(A)	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2 of the ICNG.

(1) Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence

Table 4 Construction Airborne Noise Management Levels for Other Sensitive Receivers

Land use	Where objective applies	Noise Management Level, $L_{Aeq, 15\ minute}$ – dB(A)[1]
Commercial premises	External noise level	70
Industrial premises	External noise level	75

(1) Noise management level applies when receiver is in use only.

(2) Where some nearby receivers may operate as both commercial/industrial and residential land uses, the more stringent NML should be applied. For this project, the residential NMLs are more stringent.

4.3 Noise Policy for Industry

Responsibility for the control of noise emissions in NSW is typically vested in Local Government and the NSW Environment Protection Authority (EPA). The *Noise Policy for Industry* (NPI) and relevant application notes provide a framework and methodology for deriving limit conditions for project consent and environment protection licence conditions.

The NPI is designed for large and complex industrial sources and outlines processes designed to strike a feasible and reasonable balance between the operations of industrial activities and the protection of the community from noise levels that are intrusive or unpleasant.

The NPI measurement and evaluation methodology to quantify existing ambient and background noise levels has been adopted for this assessment, with the baseline values utilised to derive construction noise criteria. The NPI assessment terminology is outlined in more detail in Appendix A of this report.

4.3.1 Assessment of prevailing weather conditions

The NPI 'Fact Sheet D: Accounting for noise-enhancing weather conditions' states:

> Two options are available to a proponent to consider meteorological effects:
>
> 1. Adopt the noise-enhancing meteorological conditions for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur – a conservative approach that considers source-to-receiver wind vectors for all receivers and F-class temperature inversions with wind speeds up to 2 m/s at night.
>
> Or
>
> 2. Determine the significance of noise enhancing conditions.

Noise emissions from the proposed development have been assessed in accordance with NPI Option 1 using 'noise enhancing' meteorological conditions. This ensures a conservative assessment and where compliance under 'worst-case' conditions are predicted then compliance during other scenarios is expected.

4.3.2 Potential sleep disturbance issues

As stated in the NPI the potential for sleep disturbance from maximum noise level events generated by premises during the night-time period needs to be considered. The term "sleep disturbance" is considered to be both awakenings and disturbance to sleep stages.

To evaluate potential sleep disturbance or awakening issues associated with the construction of the Project the NPI screening method has been adapted as follows. There is limited potential for sleep disturbance or awakening issues to occur, where:

- The predicted project night-time noise level ($L_{eq,\ 15\ minute}$ in dB(A)) at any residential receptor remains below 40 dB(A) (or the prevailing night-time background noise level plus 5 dB(A)), whichever is the greater.
- The predicted project night-time noise level (L_{max} in dB(A)) at any residential receptor remains below 52 dB(A) (or the prevailing night-time background noise level plus 15 dB(A)), whichever is the greater.

These screening method features have been adopted for likely maximum noise level events from construction vehicles associated with the Project.

4.4 NSW Road Noise Policy

The *NSW Road Noise Policy* (RNP) outlines the range of measures needed to minimise road traffic noise and its impacts. It is intended for use by acoustics specialists as well as:

- Road project proponents.
- Determining authorities and regulators involved in the approval and construction of road projects and land use developments that generate additional traffic on existing roads.
- City and transport planners and policymakers dealing with issues such as route corridors, heavy vehicle transport and building codes.

The RNP aims to identify the strategies that address the issue of road traffic noise from existing roads, new road projects, road redevelopment projects and new traffic-generating developments. In this case, the RNP is considered the suitable document to qualitatively assess potential noise emissions and impacts associated with construction traffic using public roads.

The RNP target noise criteria vary based on road type and are dependent on the development being assessed. The criteria values from the RNP were considered in the assessment of potential construction noise impacts. They are used to provide guidance on potential short-term and temporary impacts associated with heavy vehicle haulage and/or other like vehicles that may be required as part of the construction.

4.5 Vibration guidelines and standards

The effects of vibration on buildings can be divided into three main categories: human comfort (annoyance), building damage (cosmetic/structural) and sensitive equipment (scientific/medical). An overview of the applicable standards and guidelines is provided below.

- **Human Comfort (annoyance)**: The NSW Vibration Guideline provides guidance for assessing human exposure (comfort or annoyance issues) to vibration. The publication is based on British Standard (BS 6472–1992) – Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz), dated 1992.

- **Cosmetic and Structural Damage**: There is currently no Australian policy or guideline for assessing the potential for building damage (cosmetic and structural) from vibration. The British Standard BS 7385 Part 2-1993 'Evaluation and measurement for vibration in buildings Part 2' has been considered for project works where applicable. BS 7385 provides safe limit guideline values, below which vibration is considered insufficient to cause structural or cosmetic damage to buildings. If a heritage building or structure is found to be structurally unsound a more conservative standard has been adopted i.e. German Standard DIN4150 Part 3-1999 (DIN4150-3) – Structural Vibration - Effects of Vibration on Structures, dated 1999. DIN4150-3 presents a set of safe limit values below which cosmetic or structural damage is unlikely to occur.

  The NSW Vibration Guideline, BS7385 and DIN 4150-3 criteria vary based on vibration type, receptor type and are dependent on the component frequency of the vibration event. The criteria values from the NSW Vibration Guideline, BS7385 and DIN 4150-3 were considered in the assessment of potential impacts but are not reproduced here.

- **Sensitive Scientific and Medical Equipment**: Some scientific equipment (e.g. electron microscopes and microelectronics manufacturing equipment) can require more stringent objectives than those applicable to human comfort.

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> Where manufacturer's data for the identified vibration sensitive scientific and/or medical instruments are not available, generic vibration criterion (VC) curves will be adopted as vibration goals.
>
> However, as there is no sensitive scientific and medical equipment housed in nearby buildings, the assessment of vibration impacts on sensitive scientific and medical equipment is not relevant and will not be conducted in this study.

Given the distance between the proposed works and the nearest residential noise sensitive receiver, the potential vibration impacts during construction are more concerned with the impact on Human Comfort.

5 Project specific noise and vibration criteria

5.1 Construction noise and vibration

5.1.1 Construction noise management levels

The project-specific construction "Noise Management Levels" (NML), for works within and outside the recommended standard hours for construction, are presented in Table 5 below.

These NMLs have been established with due regard to the requirements of the ICNG for all identified residential (dwelling) and other sensitive (non-residential) receptors. NML for all periods are provided for completeness despite construction works limited to the recommended standard hours for construction presented in the ICNG.

For residential (dwelling) receptors the NML are based on the lowest measured RBL values presented in Table 2.

Table 5 Project specific construction noise management levels (NML)

Receiver type	Construction noise management levels, $L_{eq,\ 15\ minute}$, dB(A)				High noise affected, $L_{eq,\ 15\ minute}$, dB(A)
	Standard hours	Out-of-Hours			
	Day	Day	Evening	Night	
Residential receivers	45	40	39	35	75
Industrial	75	75	75	75	-

Construction activities would only be carried out during daytime period. Therefore, construction noise impacts will only be assessed against the daytime standard hours NMLs.

5.1.2 Construction vibration management levels

Impacts from vibration can be considered both in terms of effects on building occupants (human comfort) and the effects on the building structure (building damage). Of these considerations, the human comfort limits are the most stringent. Therefore, for occupied buildings, if compliance with human comfort limits are achieved, it will follow that compliance will be achieved with the building damage objectives.

Human comfort

The NSW Vibration Guideline provides guidance for assessing human exposure to vibration. These documents are based on *British Standard (BS 6472–1992) – Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz) dated 1992*. The vibration dose values recommended in BS 6472-1992 for which various levels of adverse comment from occupants may be expected are presented in Table 6.

Table 6 Human comfort – vibration dose values (BS 6472)

Location	Assessment period	Preferred values		Maximum values	
		z axis	x and y axes	z axis	x and y axes
Continuous vibration (m/s^2)					
Critical Areas	Daytime or Night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Daytime or Night-time	0.020	0.014	0.040	0.028
Workshops	Daytime or Night-time	0.040	0.029	0.080	0.058
Impulsive vibration (m/s^2)					
Critical Areas	Daytime or Night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Daytime or Night-time	0.64	0.46	1.28	0.92
Workshops	Daytime or Night-time	0.64	0.46	1.28	0.92
Intermittent vibration (m/s$^{1.75}$)					
Critical Areas	Daytime or Night-time	0.10		0.20	
Residences	Daytime	0.20		0.40	
	Night-time	0.13		0.26	
Offices, schools, educational institutions and places of worship	Daytime or Night-time	0.40		0.80	
Workshops	Daytime or Night-time	0.80		1.60	

(1) Daytime is 7am-10pm and Night-time is 10pm-7am.

(2) For continuous and impulsive vibration, the preferred and maximum values are weighted acceleration values (Wg for z-axis and Wd for x and y-axis)

(3) For intermittent vibration, the preferred and maximum values are Vibration Dose Values (VDVs), based on the weighted acceleration values

Building damage

German Standard DIN 4150-3-1999 Structural Vibration – Part 3 Effects of vibration on structures provides methods for evaluating the effects of vibration on structures in the absence of an Australian Standard.

The recommended limits (guide values) from DIN 4150 for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented in Table 7.

Table 7 Guideline vibration values for short term vibration on structures (mm/s)

Type of building	Guideline values for velocity (mm/s)			
	1 to 10 Hz	10 to 50 Hz	50 to 100 Hz	Vibration at horizontal plane of highest floor at all frequencies
Commercial and Industrial Building	20	20-40	40-50	40
Dwellings and buildings of similar occupancy or design	5	5-15	15-20	15
Structures that, because of their particular sensitivity to vibration cannot be classified under lines 1 and 2 and are of great intrinsic value	3	3-8	8-10	8

5.2 Operational noise

The *Noise Policy for Industry* (NPI) was released in 2017 and sets out the NSW Environment Protection Authority's (EPA) requirements for the assessment and management of noise from industry in NSW.

5.2.1 Trigger levels

The NPI describes 'trigger levels' which indicate the noise level at which feasible and reasonable noise management measures should be considered. Two forms of noise criteria are provided – one to account for 'intrusive' noise impacts and one to protect the 'amenity' of particular land uses.

- The intrusiveness of an industrial noise source is generally considered acceptable if the L_{Aeq} noise level of the source, measured over a period of 15 minutes, does not exceed the background noise level by more than 5 dB. Intrusive noise levels are only applied to residential receivers. For other receiver types, only the amenity levels apply.
- To limit continual increases in noise levels from the use of the intrusiveness level alone, the ambient noise level within an area from all industrial sources should remain below the recommended amenity levels specified in the NPI for that particular land use.

For this assessment, the area surrounding the proposal is considered to be 'rural'.

5.2.2 Project specific noise criteria

The criteria for industrial noise generated by the facility are provided in Table 8. The Project Noise Trigger Level (PNTL) is the lowest value of the intrusiveness or amenity noise level for each period and are shown in Table 8 below in bold.

Table 8 NPI noise criteria (rural amenity area)

Receiver	Period	Noise level – dB(A)			
		Recommended amenity noise level L_{eq}	Lowest measured background noise level	Project noise trigger level $L_{eq(15minute)}$	
			RBL(1)	Intrusiveness	Amenity(2),(3)
Residential receivers	Daytime	50	35	**40**	48
	Evening	45	34	**39**	43
	Night-time	40	30	**35**	38
Industrial	When in use	70	n/a	n/a	**73**

(1) RBL = Rating Background Level

(2) A -5 dB(A) correction has been applied to the amenity noise levels as there are existing industries present.

(3) The Project amenity noise level has been converted to a 15-minute level by +3 dB.

(4) The most stringent project trigger levels are bold

5.2.3 Annoying noise characteristics corrections

Sources of industrial noise can cause greater annoyance where they contain certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content. The NPI provides the following modifying factors, shown in Table 9, which are to be applied to the predicted receiver noise levels.

Table 9 NPI modifying factor corrections

Factor	Assessment / measurement	When to apply	Correction(1)
Tonal noise	One-third octave band analysis using the objective method for assessing the audibility of tones in noise – simplified method (ISO1996.2-2007 – Annex D).	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz • 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz • 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz	5 dB(2)

Factor	Assessment / measurement	When to apply	Correction[1]
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10– 160 Hz	Measure / assess source contribution C and A weighted $L_{eq,t}$ levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and: • where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2 dB(A) positive adjustment applies for the daytime period.	2 or 5 dB[2]
Intermittent noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level	The source noise heard at the receiver varies by more than 5 dB and the intermittent nature of the noise is clearly audible.	5 dB

(1) Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.

(2) Where a source emits tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

(3) Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the ISO1996-2:2007 standard.

5.2.4 Sleep disturbance criteria

As the construction works will only be undertaken during the day period there will be no sleep disturbance or night time noise impacts as a result of these works.

During normal operation of the BESS, the operational noise of the battery racks, inverters and transformers will be assessed against the sleep disturbance and night time noise criteria.

In accordance with the NPI, the sleep disturbance noise criteria for assessing the Project are presented in Table 10 below.

Table 10 Sleep disturbance Noise Criteria

Receiver type	$L_{eq,\ 15minute}$ dB(A)	L_{max} dB(A)
Residential receivers	40	52

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5.3 Road traffic noise

The RNP provides guidance, criteria and procedures for assessing noise impacts from existing, new and redeveloped roads and traffic generating developments. The assessment of road traffic noise impacts on public roads is assessed under the RNP.

Road traffic generated by the operation of the Project will not generate additional traffic on existing surrounding public roads, and as such, there will be no increase to the existing road traffic. Hence, road traffic noise impact due to operational noise will not be assessed in this study.

The construction of the Project will generate additional traffic on surrounding public roads, such as construction worker car movements and delivery and construction vehicle movements. Once construction is complete, project traffic is expected to return to levels similar to the current situation.

The RNP details a number of noise assessment criteria for various road categories and land uses. Road access to the facility will be via Burgmanns Lane from New England Highway which is a NSW state highway. Burgmanns Lane would be classified as a local road and New England Highway would be classified as a freeway.

The Application Notes for the RNP state that;

> *'for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.'*

If road traffic noise during the Project construction is within 2 dB(A) of current levels then the objectives of the RNP are met and no specific mitigation measures are required. Where the Project road traffic noise levels exceed 2 dB(A) of current levels than the consideration should be given to the actual noise levels associated with construction traffic and whether or not these levels comply with the RNP criteria as presented in Table 11.

Table 11 RNP Residential Road Traffic Noise Criteria

Road Category	Type of Project/Land Use	Assessment criteria(1) – dB(A)	
		Day 7am to 10pm	Night 10pm to 7am
Freeway/arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments.	$L_{Aeq,15hr}$ 60 (external)	$L_{Aeq,9hr}$ 55 (external)
Local roads	Existing residences affected by additional	$L_{Aeq,1hr}$ 55 (external)	$L_{Aeq,1hr}$ 50 (external)

(1) The assessment criteria for external noise levels apply at 1 metre from the facade of any affected residential receiver

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6 Construction Noise and Vibration Assessment

This section details the assessment of the construction noise and vibration impacts from the Project. Construction noise impacts predicted at nearest residential receivers have been assessed against the adopted ICNG noise management levels. Road traffic noise from the construction of the Project have been assessed against the RNP noise criteria.

6.1 Construction noise

6.1.1 Construction stages

To assess the potential noise and vibration impacts during construction, the construction scenarios provided by Accent Environmental have been used in this assessment. Typical plant and equipment for each scenario have been developed based on Resonate's past project experiences. These are summarised in Table 12.

It is understood that all construction works are proposed to be carried out during standard daytime periods (7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays).

Table 12 Construction stages and equipment sound power levels

Stage	Scenario	Equipment	No. of plant items	Individual plant item maximum L_{eq} sound power level – dB(A)
1A	Site preparation, clearing & demolition	Excavator	2	107
		Bulldozer 28 tonne	1	107
		Chainsaw	2	117[(1),(2)]
		Tree mulcher	1	115
		Light vehicle	5	94
		Dump truck	1	106
1B	Establish site compound, access roads & delivery of materials	Hand tools	2	94
		Excavator	2	107
		Light vehicle	5	94
		Bulldozer 28 tonne	1	107
		DPU / plate compactor	2	103
		Grader	1	107
		Roller 18 tonne	1	102
		Asphalt paver & tipper lorry	1	108
		Bobcat	1	104
		Telehandler	2	105
		Mobile crane	1	106

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Stage	Scenario	Equipment	No. of plant items	Individual plant item maximum L_{eq} sound power level – dB(A)
2	Delivery of BESS infrastructure	Light vehicle	5	94
		Delivery trucks / semi-trailers	4	100
		Forklift	2	85
		Mobile crane	1	106
3A	Installation of foundation for substation and BESS(s)	Light vehicle	5	94
		Piling rig	1	114(1),(2)
		Bobcat	1	104
		Crane	2	106
		Excavator	2	107
		Concrete vibrating needle	2	103
		Concrete agitator truck (discharging)	1	103
		Concrete agitator (low to mid revs)	1	107
3B	Installation of underground cabling	Light vehicle	5	94
		Vermeer trencher	2	105
		Cable laying trailer & tractor	2	103
		Loader	2	110
4	Commissioning and joint testing	Light vehicle	3	94
		Hand tools	2	94
		Cherry picker	1	95

(1) Denotes “annoying” item of equipment as defined in the ICNG (i.e. contains characteristics such as impulsiveness, tonality etc.), and as such includes a +5 dB penalty adjustment to predictions.

(2) Overall SWL assumes a maximum duration of 7.5 minutes operation in any 15 minute period.

6.1.2 Construction noise assessment methodology

Prediction of construction noise impacts from the Project has been undertaken through the use of the SoundPLAN (version 8.2) noise propagation modelling software.

The most significant factors in determining the level of noise received from construction activities are the receiver’s distance from the Project site, shielding, ground absorption and source heights. The parameters used and values adopted in the noise modelling are presented in Table 13 below.

Table 13 Construction noise modelling parameters

Parameter	Input data
Receivers	• Receivers provided by project team in shapefile format and imported into SoundPLAN • Receivers have been modelled as point receivers • Height of receivers modelled as 1.5 m
Terrain	1 metres ground contour from Geoscience Australia.
Ground surface / absorption	The agricultural land surrounding the site has been conservatively modelled with a ground cover factor of 0.5 representative of 'mixed' ground.
Source heights	Construction plant and equipment heights are modelled to be 2 m above ground
Sources	All equipment has been modelled as point sources and all equipment have been modelled to operate simultaneously.
SoundPLAN module	ISO 9613 algorithm industrial module
Met condition	Neutral meteorological condition has been modelled as construction activities will only be conducted during standard daytime period.

6.1.3 Predicted construction noise levels

Appendix C presents the predicted noise levels associated with each stage of works along with a comparison with the daytime and highly noise affected construction noise management levels (refer to Table 5). Construction noise contours are presented in Appendix D. Assessment against the evening and night-time NMLs has not been undertaken because construction works of the BESS would only be carried out during standard daytime period. The assessment is limited to the identified receivers within an approximate 2.5 km radius from the Project site boundaries (refer to Figure 2). Predicted noise levels have been based on continuous operation of the noise sources identified for each construction stage. Predictions are therefore considered to represent the worst case potential noise impacts. The predicted noise levels presented in Appendix C would typically be short-term, lasting for the duration of the construction period when works are conducted.

The following discusses the daytime and highly noise affected NMLs exceedances for each construction stage.

- Construction stage 1A:
  - The worst case predicted noise level is 56 dB(A) at receiver R01.
  - The predicted noise levels are assessed to exceed the daytime 45 dB(A) NML at 27 receivers by up to 11 dB(A), comply with the daytime NML at the rest of the receivers and achieve compliance with the highly noise affected 75 dB(A) NML at all surrounding receivers.
- Construction stage 1B:
  - The worst case predicted noise level is 51 dB(A) at receiver R01.
  - The predicted noise levels are assessed to exceed the daytime 45 dB(A) NML at 6 receivers by up to 6 dB(A), comply with the daytime NML at all other receivers and achieve compliance with the highly noise affected 75 dB(A) NML at all surrounding receivers.
- Construction stage 2:
  - The worst case predicted noise level is 44 dB(A) at receiver R01.
  - The predicted noise levels are assessed to comply with the daytime 45 dB(A) NML at all surrounding receivers and achieve compliance with the highly noise affected 75 dB(A) NML at all surrounding receivers.
- Construction stage 3A:
  - The worst case predicted noise level is 52 dB(A) at receiver R01.

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- The predicted noise levels are assessed to exceed the daytime 45 dB(A) NML at 9 receivers by up to 7 dB(A), comply with the daytime NML at all other receivers and achieve compliance with the highly noise affected 75 dB(A) NML at all surrounding receivers.

- Construction stage 3B:
  - The worst case predicted noise level is 46 dB(A) at receivers R02 and R04.
  - The predicted noise levels are assessed to exceed the daytime 45 dB(A) NML at 2 receivers by up to 1 dB(A), comply with the daytime NML at all other receivers and achieve compliance with the highly noise affected 75 dB(A) NML at all surrounding receivers.
- Construction stage 4:
  - The worst case predicted noise level is 36 dB(A) at receiver R01.
  - The predicted noise levels are assessed to comply with the daytime 45 dB(A) NML at all surrounding receivers and achieve compliance with the highly noise affected 75 dB(A) NML at all surrounding receivers.

Based on the assessed exceedances of potential construction activities at residential receivers identified in Appendix C, construction noise management and mitigation measures are provided in Section 6.4 and a draft construction noise and vibration management plan is presented in Appendix J.

6.2 Construction road traffic noise

The proposed construction traffic is anticipated to travel along New England Highway before accessing the Project site via Burgmanns Lane.

As a worst case scenario, Table 14 indicates the existing and proposed construction traffic for these roads during their applicable periods appropriate to each classification of road. The Transport for NSW's (TfNSW) Road Traffic Noise Estimator has been used to undertake construction road traffic noise predictions. Screenshots of the calculation predictions are shown in Appendix E.

Table 14 Construction road traffic noise predictions

Road name	Road type	Daytime criteria dB(A)	Period	Existing traffic volume (daytime 7 am to 10 pm)		Construction traffic volume (daytime 7 am to 10 pm)		Predicted noise level – dB(A)	
				Light	Heavy	Light	Heavy	Existing	Future
Burgmanns Lane	Local Road	55	1 hour	34(1)	6(1) (2)	16(1)	2(1) (2)	58	59
New England Highway	Freeway	60	15 hour	3082(1)	543(1) (2)	160(1)	20(1) (2)	63	64

(1) Traffic volume derived from the project's traffic study provided by Valent Energy.

(2) Heavy vehicle volumes have been assumed to be 15% of the hourly or 15-hourly traffic volumes.

Based on the above traffic noise predictions, the following have been assessed of the construction road traffic noise levels:

- proposed construction traffic along Burgmanns Lane during the worst case 1-hour traffic flows during daytime period is not predicted to increase the existing traffic noise levels by more than 2 dB at nearest residential buildings.

- proposed construction traffic along New England Highway during the worst case 15-hour traffic flows during daytime period is not predicted to increase the existing traffic noise levels by more than 2 dB at nearest residential buildings.

Due to construction road traffic noise predicted to not increase by more than 2 dB, the implementation of management and mitigation measures will not be necessary.

6.3 Construction vibration

No vibration intensive activities are proposed to occur near any receiver. Hence, no impacts are expected to occur given the significant distance to the nearest receiver building, which is more than 300 m from the site boundary.

6.4 Construction noise management and mitigation measures

The management measures have been informed from guidance provided in the ICNG which promotes principles of best management practice and community notification of likely noise impacts.

It will be important for the contractor to undertake all reasonable and feasible measures to reduce noise impacts and minimise impact potential through programming works to minimise duration and liaise with affected landowners and local communities throughout the construction program. All Contractors commissioned by the client to undertaken construction works associated with the Project are recommended to adhere to all noise management and mitigation measures recommended.

Construction works should adopt Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA) practices as addressed in the ICNG. BMP includes factors discussed within this report and encouragement of a project objective to reduce noise emissions. BATEA practices involve incorporating the most advanced and affordable technology to minimise noise emissions. The principles and proactive noise management measures presented in Table 15 are to be considered for implementation.

Table 15 Recommended construction noise management and mitigation measures

Construction phase	Recommended measure
Planning	Construction works are to be undertaken during the ICNG standard daytime construction hours (i.e. 7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays)
	Where possible, consider the application of alternative, low-impact construction techniques. For example, Ripping or cutting/sawing and grinding instead of rock hammering, or vacuum excavation instead of small scale earthworks
	A Construction Noise and Vibration Management Plan (CNVMP) should be developed to manage noise and vibration issues during construction.
Easement layout	Easement entry and exit points will be located as far as possible from sensitive receivers, taking into account the importance of safe access.
	Trucks will not queue up outside residential properties. No trucks will arrive on site or be permitted to queue near sensitive receivers prior to the 7:00 am start time unless required by road safety considerations.
	Training will be provided to all project personnel, including relevant sub-contractors on noise and vibration requirements from this plan through inductions, toolboxes and targeted awareness training.

Construction phase	Recommended measure
	All relevant staff and sub-contractors will be informed of areas and work practises where potential noise impacts have been identified.
Training	Keep horn signals between drivers to a minimum.
	Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.
	Truck drivers will limit compression braking as far as practicable.
Contractor management	Switch off generators when not in use.
Noise source mitigation	Dampen or line metal trays as necessary.
	Shut down or throttle down machinery when not in operation.
	Avoid simultaneous operation of noisy plant within discernible range of a sensitive receiver
	Ensure equipment is operated in the correct manner including replacement of engine covers, repair of defective silencing equipment, tightening of rattling components, repair of leakages in compressed air lines and shutting down equipment not in use.
	Direct noise sources such as vent outlets, generators, etc. will be located and orientated away from the residences
	Plant will be fitted with noise control devices, where practicable, including acoustic lining of engine bays and air intake / discharge silencers
	Ensure that all doors/hatches are shut during operation of plant and equipment.
	Check hatches/enclosures regularly to ensure that seals are in good working order and doors close properly against seals.
	Avoid dropping materials from height.
	Use residential-grade mufflers on plant.
	Use dampened bits on impulsive tools such as jackhammers to avoid 'ringing' noise.
	An acoustic shroud (skirt) should be installed on hydraulic rockbreakers when work is undertaken at the north-west corner of the site near receiver R1.
	Ensure truck movements are kept to a minimum, i.e. that trucks are fully loaded on each trip.
	Use temporary screening around immobile plant. Acoustic screens may be constructed from either a layer of 10 kg/m^2 loaded vinyl acoustic curtain (product name Wavebar from Pyrotek Noise Control) or minimum 9 mm thick plywood hoarding. Gaps at joints of the acoustic screen are to be sealed by overlapping the loaded vinyl or plywood, or with silicon mastic on the plywood hoarding.
Community consultation	Provide at least five and not more than 14 days' notice to affected receivers prior to starting works.
	Provide signage detailing who is undertaking the works and a 24-hour contact number.
	Where there are complaints about noise from an identified work activity, review and implement, where feasible and reasonable, action additional control measures.

Construction phase	Recommended measure
	Consult with adjacent utility owners regarding the minimal risk of vibration impacts associated with the proposal.
	In consultation with the community, preference may be given to avoiding cumulative impacts by avoiding the con-current completion of phases of construction. Alternatively, impacted receivers may prefer a shorter works duration where this requires con-current completion of construction phases.

7 Operational noise and vibration assessment

This section details the assessment of the operational noise and vibration impacts from the Project. Operational noise impacts predicted at nearest residential receivers have been assessed against the adopted NPI noise criteria.

7.1 BESS operational noise

The main noise sources associated with the operation of the BESS facility consists of the following:

- Battery enclosure – up to 136 x battery enclosure would be installed.
- PCS – up to 68 x PCS would be installed
- Medium voltage (MV) transformer – up to 34 x 33 kV MV transformers would be installed.
- High voltage (HV) transformer – 2 x 132 kV HV transformer would be installed within the substation area of the Project site.

The L_{Aeq} sound power levels of plant items from the proposed operations are given in Table 16. The 1/1 octave band frequency noise levels of each plant item are presented in Table 17.

Table 16 Estimated equipment sound power levels

Equipment	Number of plant item	Sound power level Leq – dB(A) (Individual plant item)
Battery enclosure	136	85[(1)]
PCS at 100% duty factor	68	93[(2)]
MV transformer	34	75
HV transformer	2	84

(1) This sound power level has been based on the sound data provided by the equipment manufacturer.

(2) This sound power level is provided by the equipment manufacturer.

Table 17 Equipment sound power spectra

Equipment	Sound Power Level in dB at Octave Band Centre Frequency (Hz)								Sound Power Level, dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
Battery enclosure	91	95	81	82	81	75	65	63	85
PCU	65	73	86	87	88	89	82	72	93
MV transformer	64	66	70	62	72	68	62	52	75
HV transformer	87	89	84	83	78	73	68	58	84

It is understood that the charge and discharge rates of typical BESS facilities generally do not occur at the rated capacity of the BESS. The maximum utilisation for a BESS is typically 80% of peak system capacity during day and evening periods, and usually 40% during the night-time period. However, to undertake a conservative operational noise impact assessment the worst case 100% operational utilisation has been assessed for all periods.

Noise from the transformers and PCUs can be tonal in nature. Therefore, a 5 dB penalty have been applied to the predicted noise levels at the receivers to account for tonality in accordance with Table C.1 of the NPI.

The noise emissions from the BESS operations are continuous and do not emit peak noise levels for an instant or very short time period. Therefore, the operational noise from the Project will only be assessed against the sleep disturbance L_{Aeq} criterion and not the L_{Amax} criterion.

7.1.1 Methodology

In order to determine the acoustical impact of the Project, a computer model incorporating all significant noise sources; the closest potentially affected residential properties, and the intervening terrain has been prepared.

The computer model was prepared using the SoundPLAN noise propagation modelling software (Version 8.2) Industrial Module which allows the use of various internationally recognised noise prediction algorithms. The CONCAWE algorithm, which is suitable for the assessment of large industrial plants, has been selected for this assessment because it also enables meteorological influences to be assessed.

The parameters used and values adopted in the noise modelling are presented in Table 18 below.

Table 18 Operational noise modelling parameters

Parameter	Input data
Receivers	• Receivers provided by project team in shapefile format and imported into SoundPLAN • Receivers have been modelled as point receivers • Height of receivers modelled as 1.5 m
Terrain	1 m ground contour from Geoscience Australia.
Ground surface / absorption	The agricultural land surrounding the site has been conservatively modelled with a ground cover factor of 0.5 representative of 'mixed' ground.
Sources	• Noise emission sources associated with the Project as detailed in Table 16. • All noise emitting equipment has been modelled to operate simultaneously.
SoundPLAN module	CONCAWE industrial module
Meteorological condition	Neutral meteorological conditions for all periods. • Pasquill category D • No wind • 70% relative humidity • 20˚C temperature • 1013 mbar air pressure
	Noise enhancing meteorological conditions for daytime and evening periods. • Pasquill category D • 3 m/s • 70% relative humidity • 20˚C temperature • 1013 mbar air pressure
	Noise enhancing (temperature inversion) meteorological conditions for night-time period. • Pasquill category F • 2 m/s • 70% relative humidity • 10˚C temperature • 1013 mbar air pressure

7.1.2 Predicted operational noise levels

The predicted operational noise levels for the day, evening and night-time periods are presented in Appendix F and the operational noise contours are presented in Appendix G.

The highest predicted operational noise level during neutral weather condition is 54 dB(A) at residential receivers R01 during all periods.

The highest predicted operational noise level during noise enhancing weather conditions is 58 dB(A) at residential receiver R01 during all periods.

7.1.3 Discussion

The following discusses the predicted operational noise levels at surrounding receivers.

- Neutral weather condition:
  - The BESS operation during the daytime is expected to exceed the NPI daytime 40 dB(A) criterion at residential receivers R01 to R09, R13, R16 and R20. Operational noise impacts at all other receivers have been predicted to comply with the daytime criterion. The daytime operational noise levels during neutral weather condition are predicted to exceed the daytime criterion by up 13 dB(A).
  - The BESS operation during the evening is expected to exceed the NPI evening 39 dB(A) criterion at residential receivers R01 to R09, R13, R15 to R17, R19 and R20. The evening operational noise levels during neutral weather condition are predicted to exceed the evening criterion by up to 14 dB(A).
  - The BESS operation during the night-time is expected to exceed the NPI evening 35 dB(A) criterion at most receivers, except receivers R10, R11, R24, R28, R29, R30 and R33. The night-time operational noise levels during neutral weather condition are predicted to exceed the night-time criterion by up to 18 dB(A).
  - The night-time operational noise levels have been predicted to exceed the sleep disturbance L_{Aeq} 40 dB(A) criterion at residential receivers R01 to R09, R13, R16 and R20. Operational noise impacts at all other receivers have been predicted to comply with the sleep disturbance L_{Aeq} criterion. The night-time operational noise levels during neutral weather condition are predicted to exceed the sleep disturbance criterion by up to 13 dB(A).
- Noise enhancing weather conditions (adverse wind during day and evening, and temperature inversion during night-time):
  - The BESS operation during the daytime is expected to exceed the NPI daytime 40 dB(A) criterion at most surrounding receivers, except receivers R10, R11, R24, R28, R29, R30 and R33. The daytime operational noise levels during noise enhancing weather condition are predicted to exceed the daytime criterion by up 17 dB(A).
  - The BESS operation during the evening is expected to exceed the NPI evening 39 dB(A) criterion at most surrounding receivers, except receivers R10, R11, R24, R28, R29, R30 and R33. The evening operational noise levels during noise enhancing weather condition are predicted to exceed the evening criterion by up to 18 dB(A).
  - The BESS operation during the night-time is expected to exceed the NPI evening 35 dB(A) criterion at most receivers, except receivers R10, R11, R24, R30 and R33. The night-time operational noise levels during noise enhancing weather condition are predicted to exceed the night-time criterion by up to 22 dB(A).
  - The night-time operational noise levels have been predicted to exceed the sleep disturbance L_{Aeq} 40 dB(A) criterion at most receivers, except receivers R10, R11, R24, R28, R29, R30 and R33. The night-time operational noise levels during noise enhancing weather condition are predicted to exceed the sleep disturbance criterion by up to 17 dB(A).

Marginal exceedances of 1 to 2 dB(A) are deemed to have negligible impact as ≤ 2 dB exceedance is typically not discernible by the average human ear. Therefore, predicted levels that exceed the noise criteria by 2 dB or less are considered to achieve compliance with the criteria.

Based on the assessed exceedances, noise mitigation measures have been recommended and are presented in Section 7.4.

7.2 Operational road traffic noise

The proposed operational traffic is anticipated to travel along New England Highway before accessing the Project site via Burgmanns Lane. The existing traffic Burgmanns Lane are minimal, with generally up to one light vehicle or heavy vehicle per hour each way.

The following operational road traffic scenarios have been advised by the project traffic study:

- Daily routine maintenance to be carried out by two (2) people. It is assumed that the daily traffic generation will not exceed two vehicle movements per day to the local road network, with all other movements being internal to the site.
- Occasional maintenance will occur when components of the development need to be replaced, such as replacing BESS unit components. This is expected to occur only very occasionally, and will have no discernible impact on the external road network.
- Visitors to the site such as office based staff and courier deliveries etc.

As a worst case scenario, Table 19 indicates the existing and proposed operational traffic for these roads during their applicable periods appropriate to each classification of road. The Transport for NSW's (TfNSW) Road Traffic Noise Estimator has been used to undertake construction road traffic noise predictions.

Table 19 Operational road traffic noise predictions

Road name	Road type	Daytime criteria dB(A)	Period	Existing traffic volume (daytime 7 am to 10 pm)		Operational traffic volume (daytime 7 am to 10 pm)		Predicted noise level – dB(A)	
				Light	Heavy	Light	Heavy	Existing	Future
Burgmanns Lane	Local Road	55	1 hour	34 (1)	6 (1) (2)	2 (1)	1 (1) (2)	58	58
New England Highway	Freeway	60	15 hour	3,082 (1)	543 (1) (2)	2 (1)	1 (1) (2)	63	63

(1) Traffic volume derived from the project's traffic study provided by Valent Energy.

(2) Heavy vehicle volumes have been assumed to be 15% of the hourly or 15-hourly traffic volumes.

Based on the above traffic noise predictions, the following have been assessed of the operational road traffic noise levels:

- proposed operational traffic along Burgmanns Lane during the worst case 1-hour traffic flows during daytime period is not predicted to increase the existing traffic noise levels by more than 2 dB at nearest residential buildings.
- proposed operational traffic along New England Highway during the worst case 15-hour traffic flows during daytime period is not predicted to increase the existing traffic noise levels by more than 2 dB at nearest residential buildings.

Resonate

7.3 Operational vibration

No vibration intensive plant/equipment or activities are proposed to occur during standard operation onsite, therefore no vibration impacts are anticipated.

7.4 Recommended operational noise mitigation measures

Based on the predicted exceedances, the following noise mitigation measures would need to be implemented to ensure that the BESS operations achieve compliance with the NPI noise criteria.

- Install acoustic enclosure to each PCU. Each acoustic enclosure should provide an insertion loss of at least 20 dB(A).
- Install 4 m high noise barriers around the HV transformers. Noise barriers should be of solid material with surface density of at least 15 kg/m^3 (concrete, solid plywood, Colorbond steel etc) and have no gaps at the bottom of the wall or along its length. Sound absorptive treatment, such as Pyrotek Reapor, to the internal side if the barrier will be required.
- Provide architectural acoustic treatment to residential receiver R01 as the operational noise impact at this receiver would still exceed the night-time criterion after the above mitigation measures are implemented. Architectural acoustic treatment to the external facades of the existing residential building of R01 would improve the sound insulation of facades thereby reducing external extraneous noise intrusion and improving the internal amenity of the property. Architectural acoustic treatment would typically involve upgrading of external glazing and doors, and installing insulation to the roof space. Architectural acoustic treatment is considered to be the most appropriate measure to implement for this receiver as the operational noise exceedances only occur during the night-time period where residents would typically be situated indoors. Therefore, improving the internal sound insulation of the facades would allow additional external noise sources, such as the Project's operational noise, to be sufficiently attenuated.

The noise mitigation measures have been included in the noise model and the predicted results during noise enhancing weather conditions are presented in Appendix H and the noise contours are presented in Appendix I.

It is also recommended that the agreed mitigation measures should be further developed during the detailed design stage of the project when the equipment selection for the project is finalised.

Other approaches to reduce noise levels that could be considered include:

- Requiring suppliers to reselect equipment with lower noise emissions.
- Noise barriers or mounds around the BESS.
- Adjusting fan speeds to account for reduced cooling capacity overnight.

7.5 Cumulative operational noise

The operational noise of the proposed Tamworth BESS may generate cumulative impact with the existing Tamworth 330kV substation on surrounding residential receivers. The receivers that would potentially be impacted by the cumulative operational noise of the proposed BESS and the existing substation are receivers surrounding the substation that would include receivers R03 to R09, R13, R15 and R21.

To assess the cumulative impact of the project, the predicted Tamworth BESS operational noise levels have been compared against the L_{A90} noise levels measured at noise logger location L1. The background noise levels are used for assessing cumulative impact because noise from substations is typically constant and continuous with no peaks and through. Therefore, L_{A90} would be the most appropriate descriptor for assessing noise from the substation.

The predicted Tamworth BESS operational noise levels at receivers R03 to R09, R13, R15 and R21 are found to be at least 10 dB(A) higher than the measured average daytime, evening and night-time L_{A90} levels. Therefore, the cumulative operational noise levels would likely be dominated by the Tamworth BESS, which would mean that the cumulative noise impacts at these receivers would exceed the day, evening and night criteria. Therefore, noise mitigation measures recommended in Section 7.4 would need to be implemented to ensure that surrounding receivers are not adversely impacted.

Resonate

8 Conclusion

This report presents the results of the assessment of the potential noise impacts associated with the Project. This assessment has been carried out in accordance with NSW regulatory requirements identified in the SEARs issued for the development.

8.1 Construction noise and vibration

The construction noise and vibration assessment was undertaken using plant and equipment representative of the construction methodologies provided by Accent Environmental. The assessment identifies the following regarding the Project's construction activities:

- construction activities would likely exceed the construction noise management levels at up to 27 residences for the noisiest construction activity (1A).
- worst case predicted construction noise level is 56 dB(A) at residential receiver R01.
- exceedances of up to 11 dB have been predicted.
- there are no highly noise affected receivers.
- due to the predicted exceedances, construction noise management and mitigation measures have been recommended in this report and should be considered for implementation.
- a draft construction noise and vibration management plan has been prepared and presented in Appendix J.
- Construction road traffic noise levels along Burgmanns Lane and New England Highway have been predicted to not increase the existing road traffic noise by more than 2 dB.
- Due to construction road traffic noise not predicted to increase by more than 2 dB, management and mitigation measures to control construction road traffic noise would not be necessary.
- No vibration impacts are expected to occur given the significant distance to the nearest receiver building, which is approximately more than 300 m from the site boundary.

8.2 Operational noise

Operational noise and vibration assessment associated with the Project was conducted. The assessment identifies the following regarding the Project's operational noise:

- The predicted 100% utilisation operational noise levels during neutral weather condition show that:
  - The BESS operation during the daytime is expected to exceed the NPI daytime 40 dB(A) criterion at residential receivers R01 to R09, R13, R16 and R20. Operational noise impacts at all other receivers have been predicted to comply with the daytime criterion. The daytime operational noise levels during neutral weather condition are predicted to exceed the daytime criterion by up 13 dB(A).
  - The BESS operation during the evening is expected to exceed the NPI evening 39 dB(A) criterion at residential receivers R01 to R09, R13, R15 to R17, R19 and R20. The evening operational noise levels during neutral weather condition are predicted to exceed the evening criterion by up to 14 dB(A).
  - The BESS operation during the night-time is expected to exceed the NPI evening 35 dB(A) criterion at most receivers, except receivers R10, R11, R24, R28, R29, R30 and R33. The night-time operational noise levels during neutral weather condition are predicted to exceed the night-time criterion by up to 18 dB(A).
  - The night-time operational noise levels have been predicted to exceed the sleep disturbance LAeq 40 dB(A) criterion at residential receivers R01 to R09, R13, R16 and R20. Operational noise impacts at all other receivers have been predicted to comply with the sleep disturbance LAeq criterion. The night-time operational noise levels during neutral weather condition are predicted to exceed the sleep disturbance criterion by up to 13 dB(A).

- The predicted 100% utilisation operational noise levels during noise enhancing weather conditions show that:
  - The BESS operation during the daytime is expected to exceed the NPI daytime 40 dB(A) criterion at most surrounding receivers, except receivers R10, R11, R24, R28, R29, R30 and R33. The daytime

operational noise levels during noise enhancing weather condition are predicted to exceed the daytime criterion by up 17 dB(A).

- The BESS operation during the evening is expected to exceed the NPI evening 39 dB(A) criterion at most surrounding receivers, except receivers R10, R11, R24, R28, R29, R30 and R33. The evening operational noise levels during noise enhancing weather condition are predicted to exceed the evening criterion by up to 18 dB(A).
- The BESS operation during the night-time is expected to exceed the NPI evening 35 dB(A) criterion at most receivers, except receivers R10, R11, R24, R30 and R33. The night-time operational noise levels during noise enhancing weather condition are predicted to exceed the night-time criterion by up to 22 dB(A).
- The night-time operational noise levels have been predicted to exceed the sleep disturbance LAeq 40 dB(A) criterion at most receivers, except receivers R10, R11, R24, R28, R29, R30 and R33. The night-time operational noise levels during noise enhancing weather condition are predicted to exceed the sleep disturbance criterion by up to 17 dB(A).

Based on the assessed exceedances, noise mitigation options have been developed and presented in Section 7.4. Operational noise mitigation measure would consist of:

- Installing acoustic enclosure to each PCU. Each acoustic enclosure should provide an insertion loss of at least 20 dB(A).
- Installing 4 m high noise barriers around the HV transformers. Noise barriers should be of solid material with surface density of at least 15 kg/m3 (concrete, solid plywood, Colorbond steel etc) and have no gaps at the bottom of the wall or along its length. Sound absorptive treatment, such as Pyrotek Reapor, to the internal side if the barrier will be required.
- Provide architectural acoustic treatment to residential receiver R01 as the operational noise impact at this receiver would still exceed the night-time criterion after the above mitigation measures are implemented. Architectural acoustic treatment to the external facades of the existing residential building of R01 would improve the sound insulation of facades thereby reducing external extraneous noise intrusion and improving the internal amenity of the property. Architectural acoustic treatment would typically involve upgrading of external glazing and doors, and installing insulation to the roof space. Architectural acoustic treatment is considered to be the most appropriate measure to implement for this receiver as the operational noise exceedances only occur during the night-time period where residents would typically be situated indoors. Therefore, improving the internal sound insulation of the facades would allow additional external noise sources, such as the Project's operational noise, to be sufficiently attenuated.

It is also recommended that the agreed mitigation measure should be further developed during the detailed design stage of the project when the equipment selection for the project is finalised.

Cumulative noise impacts at surrounding receivers are expected to be dominated by the Project. This is due to the Tamworth BESS operational noise levels being predicted to be more than 10 dB(A) higher than the existing average L_{A90} noise levels. This would mean that the cumulative noise impacts at surrounding receivers would exceed the NPI noise criteria. Therefore, noise mitigation measures recommended in Section 7.4 would need to be implemented to ensure that surrounding receivers are not adversely impacted.

Additional traffic associated with the Project is likely to have negligible impacts on the existing road traffic noise levels and therefore, will have no adverse impact on surrounding receivers.

No vibration intensive plant/equipment or activities are proposed to occur during standard operation onsite, therefore no vibration impacts are anticipated.

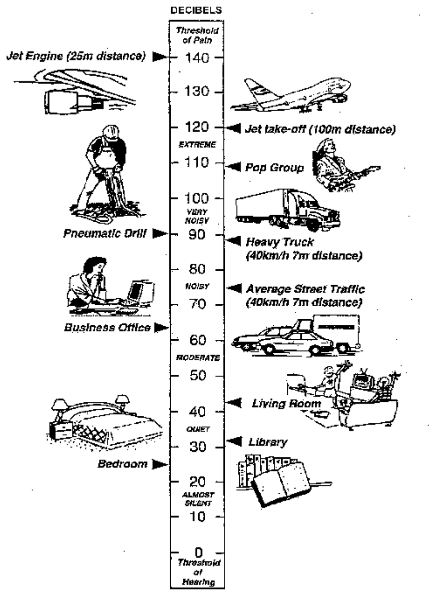
Resonate

Appendix A – Acoustic Terminology

A-weighted sound pressure	The human ear is not equally sensitive to sound at different frequencies. People are more sensitive to sound in the range of 1 to 4 kHz (1000 – 4000 vibrations per second) and less sensitive to lower and higher frequency sound. During noise measurement an electronic '*A-weighting*' frequency filter is applied to the measured sound level *dB(A)* to account for these sensitivities. Other frequency weightings (B, C and D) are less commonly used. Sound measured without a filter is denoted as linear weighted dB(linear).
Ambient noise	The total noise in a given situation, inclusive of all noise source contributions in the near and far field.
Community annoyance	Includes noise annoyance due to: • character of the noise (e.g. sound pressure level, tonality, impulsiveness, low-frequency content) • character of the environment (e.g. very quiet suburban, suburban, urban, near industry) • miscellaneous circumstances (e.g. noise avoidance possibilities, cognitive noise, unpleasant associations) • human activity being interrupted (e.g. sleep, communicating, reading, working, listening to radio/TV, recreation).
Compliance	The process of checking that source noise levels meet with the noise limits in a statutory context.
Cumulative noise level	The total level of noise from all sources.
dB(A)	dB(A) denotes a single number sound pressure level that includes a frequency weighting ("A-weighting") to reflect the subjective loudness of the sound level. The frequency of a sound affects its perceived loudness. Human hearing is less sensitive at low and very high frequencies, and so the A-weighting is used to account for this effect. An A-weighted decibel level is written as dB(A).
Extraneous noise	Noise resulting from activities that are not typical to the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
Feasible and reasonable measures	Feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors: • Noise mitigation benefits (amount of noise reduction provided, number of people protected). • Cost of mitigation (cost of mitigation versus benefit provided). • Community views (aesthetic impacts and community wishes). • Noise levels for affected land uses (existing and future levels, and changes in noise levels).

Resonate

Impulsiveness	Impulsive noise is noise with a high peak of short duration or a sequence of these peaks. Impulsive noise is also considered annoying.
Low frequency	Noise containing major components in the low-frequency range (20 to 250 Hz) of the frequency spectrum.
Noise criteria	The general set of non-mandatory noise levels for protecting against intrusive noise (for example, background noise plus 5 dB) and loss of amenity (e.g. noise levels for various land use).
Noise level (goal)	A noise level that should be adopted for planning purposes as the highest acceptable noise level for the specific area, land use and time of day.
Noise limits	Enforceable noise levels that appear in conditions on consents and licences. The noise limits are based on achievable noise levels, which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action.
Performance-based goals	Goals specified in terms of the outcomes/performance to be achieved, but not in terms of the means of achieving them.
Rating Background Level (RBL)	The rating background level is the overall single figure background level representing each day, evening and night time period. The rating background level is the 10th percentile min L_{A90} noise level measured over all day, evening and night time monitoring periods.
Receptor	The noise-sensitive land use at which noise from a development can be heard.
Sleep disturbance	Awakenings and disturbance of sleep stages.
Sound and decibels (dB)	Sound (or noise) is caused by minute changes in atmospheric pressure that are detected by the human ear. The ratio between the quietest noise audible and that which should cause permanent hearing damage is a million times the change in sound pressure. To simplify this range the sound pressures are logarithmically converted to decibels from a reference level of 2 x 10-5 Pa. The picture below indicates typical noise levels from common noise sources.



dB is the abbreviation for decibel – a unit of sound measurement. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

Sound power Level (SWL)

The sound power level of a noise source is the sound energy emitted by the source. Notated as SWL, sound power levels are typically presented in *dB(A)*.

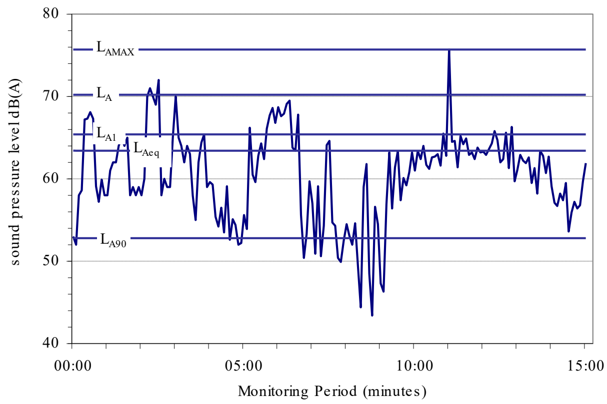
Sound Pressure Level (SPL)

The level of noise, usually expressed as SPL in *dB(A)*, as measured by a standard sound level meter with a pressure microphone. The sound pressure level in *dB(A)* gives a close indication of the subjective loudness of the noise.

Statistic noise levels

Noise levels varying over time (e.g. community noise, traffic noise, construction noise) are described in terms of the statistical exceedance level.

A hypothetical example of A weighted noise levels over a 15 minute measurement period is indicated in the following figure:



Key descriptors:

- L_{Amax}: Maximum recorded noise level.

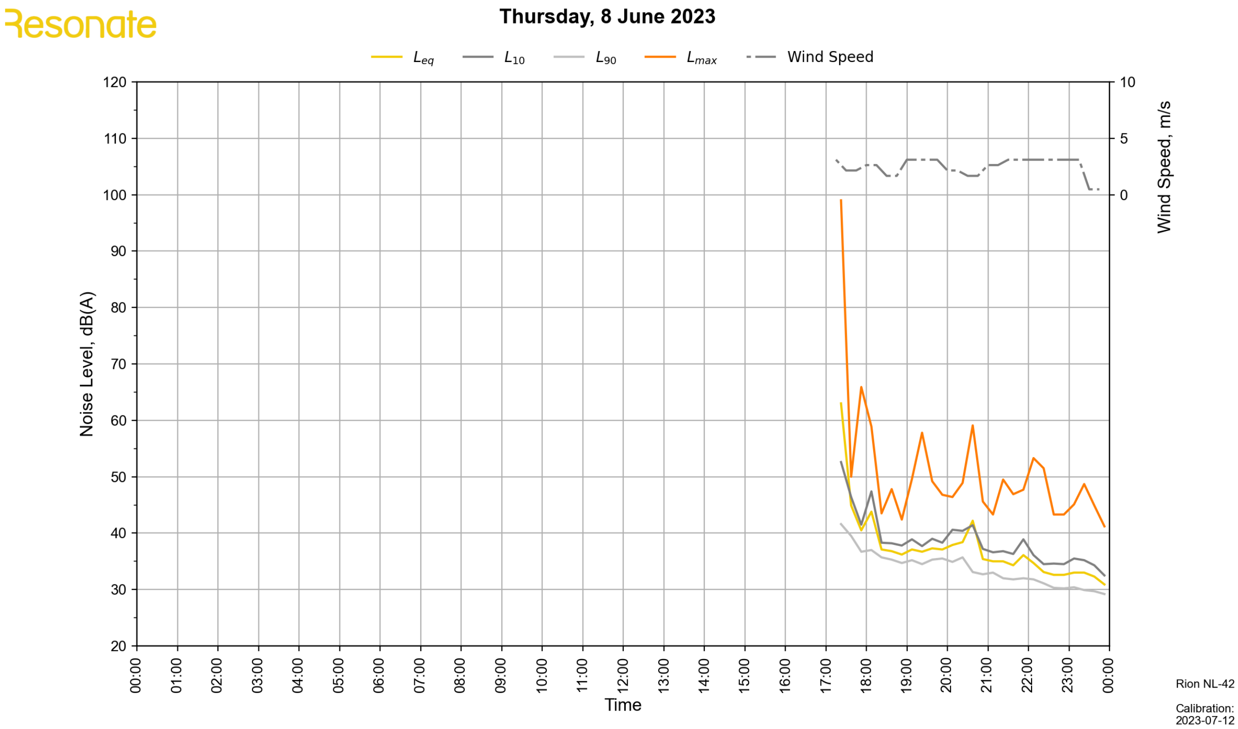
- L_{A1}: The noise level exceeded for 1% of the 15 minute interval.
- L_{A10}: Noise level present for 10% of the 15 minute interval. Commonly referred to the average maximum noise level.
- L_{Aeq}: Equivalent continuous (energy average) A-weighted sound pressure level. It is defined as the steady sound level that contains the same amount of acoustic energy as the corresponding time-varying sound.
- L_{A90}: Noise level exceeded for 90% of time (background level). The average minimum background sound level (in the absence of the source under consideration).

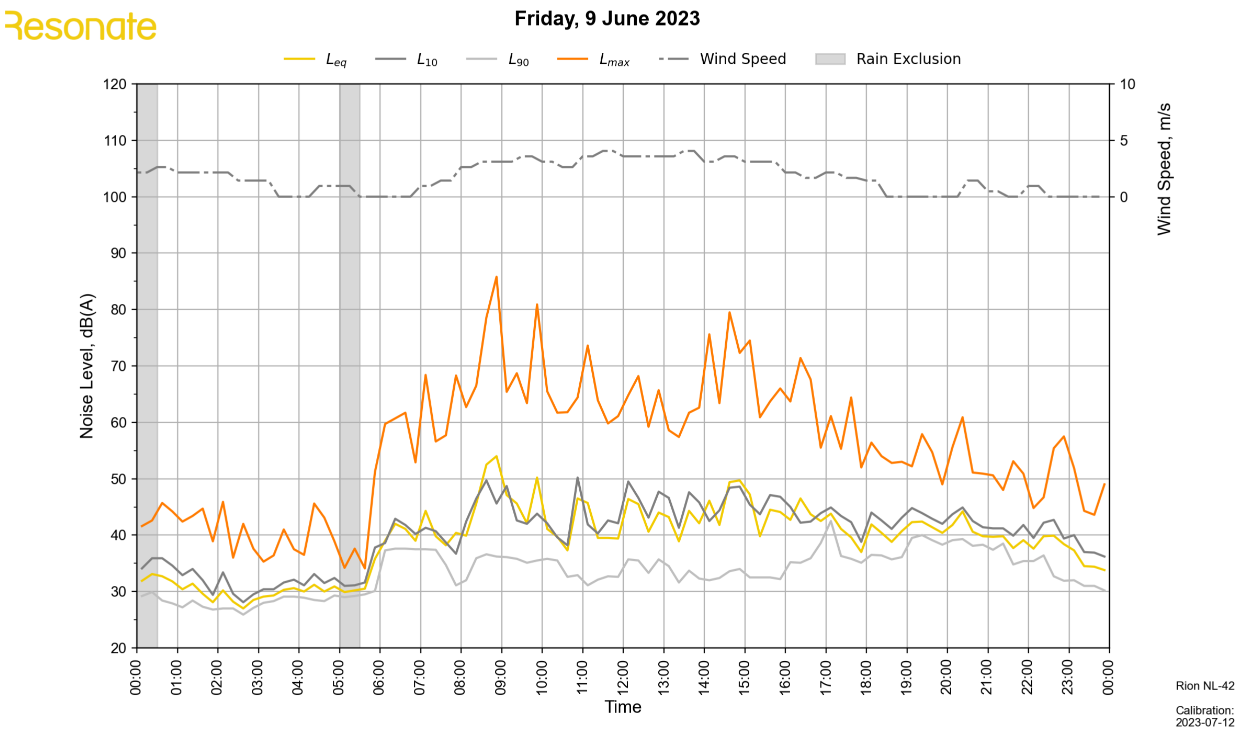
Threshold	The lowest sound pressure level that produces a detectable response (in an instrument/person).
Tonality	Tonal noise contains one or more prominent tones (and characterised by a distinct frequency components) and is considered more annoying. A 2 to 5 dB(A) penalty is typically applied to noise sources with tonal characteristics

Resonate

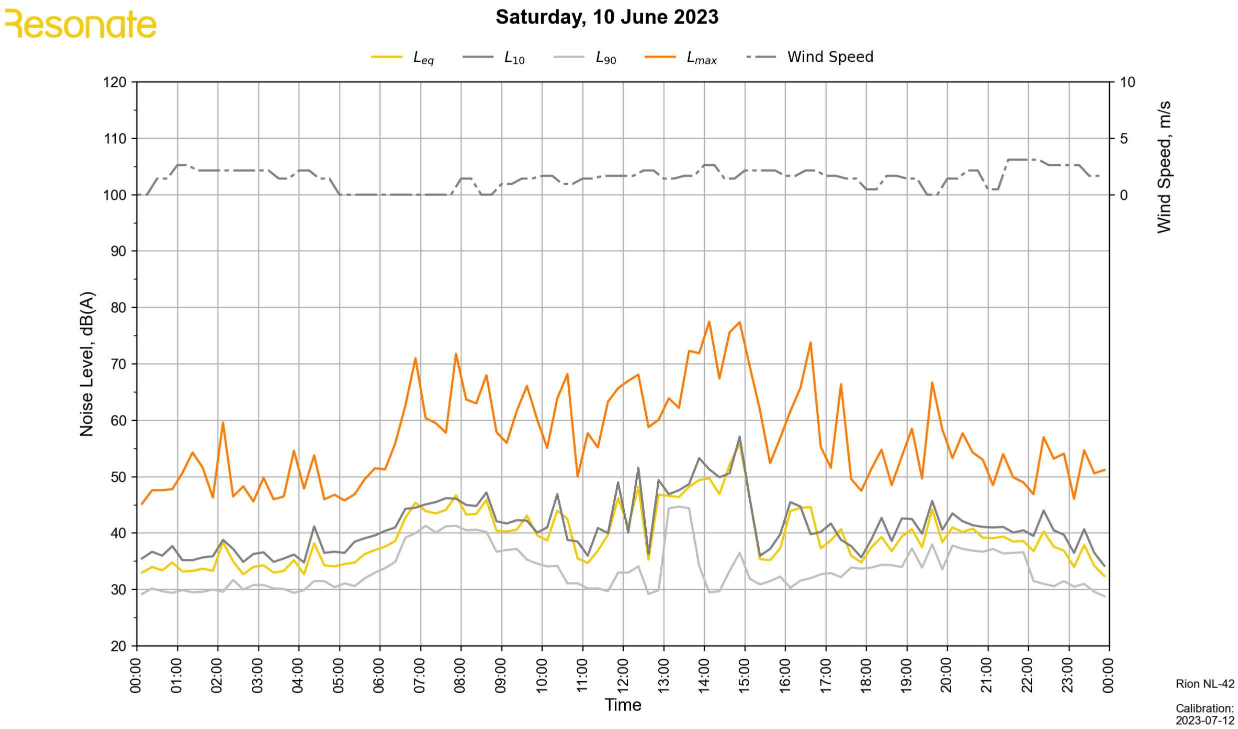
Appendix B – Noise Logging Graphs

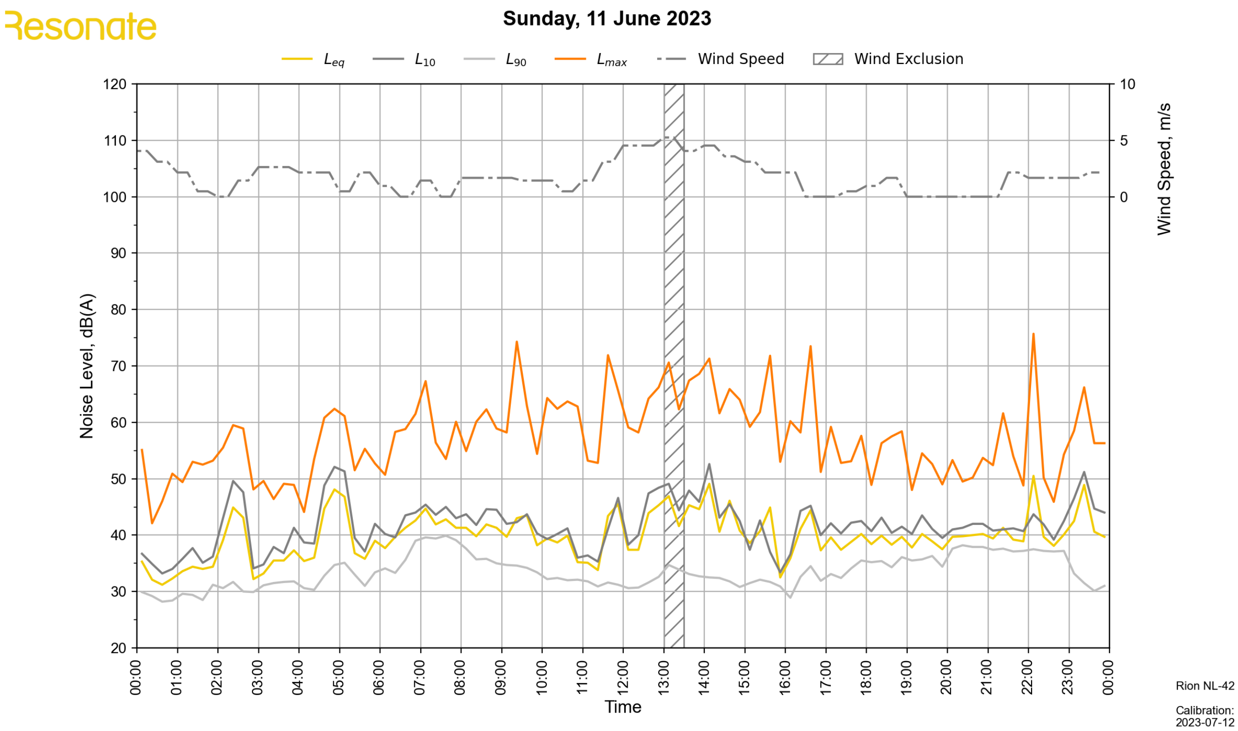
Logger Location 1



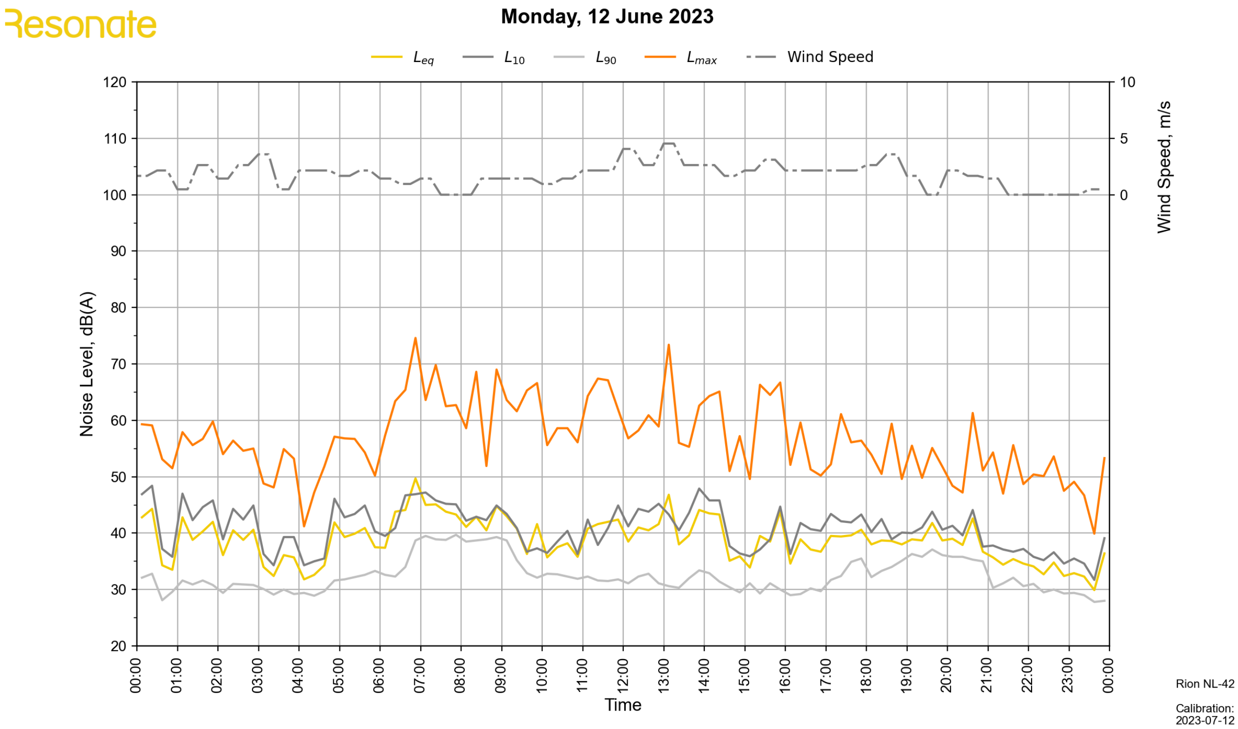


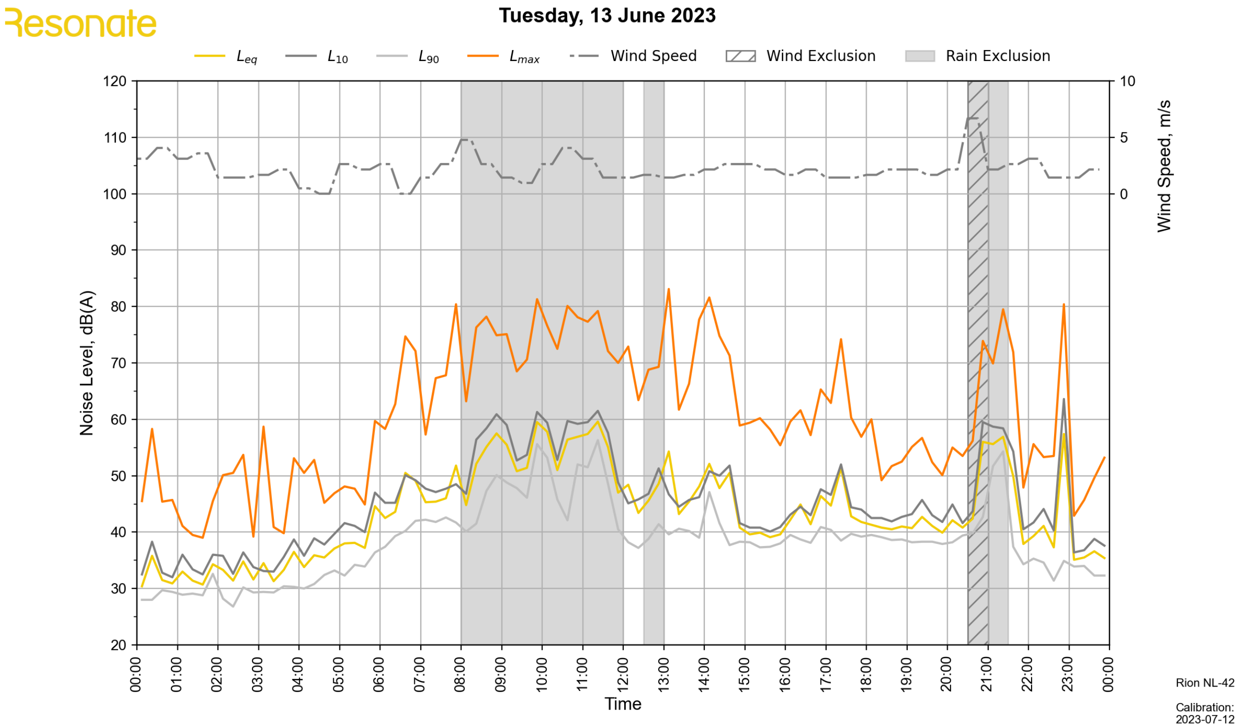
Resonate

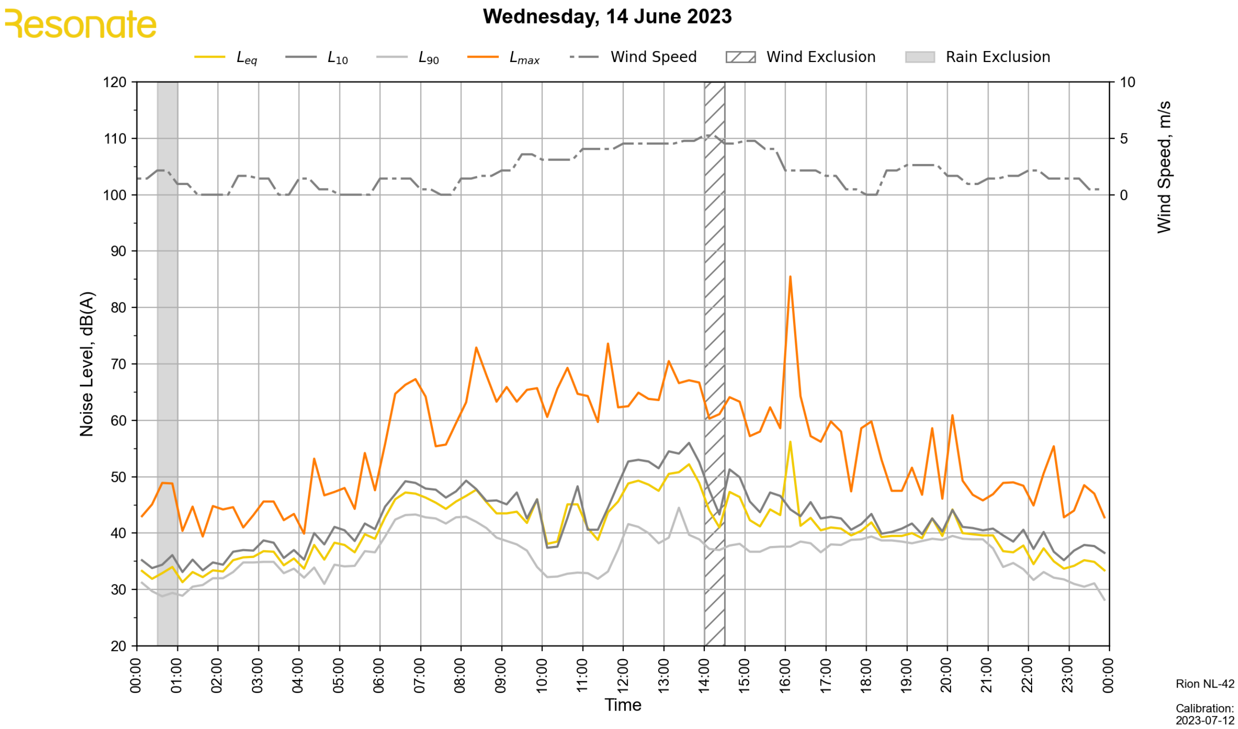

Resonate
Saturday, 10 June 2023
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
120
110
100
90
80
70
60
50
40
30
20
10
5
0
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Time
Rion NL-42
Calibration:
2023-07-12

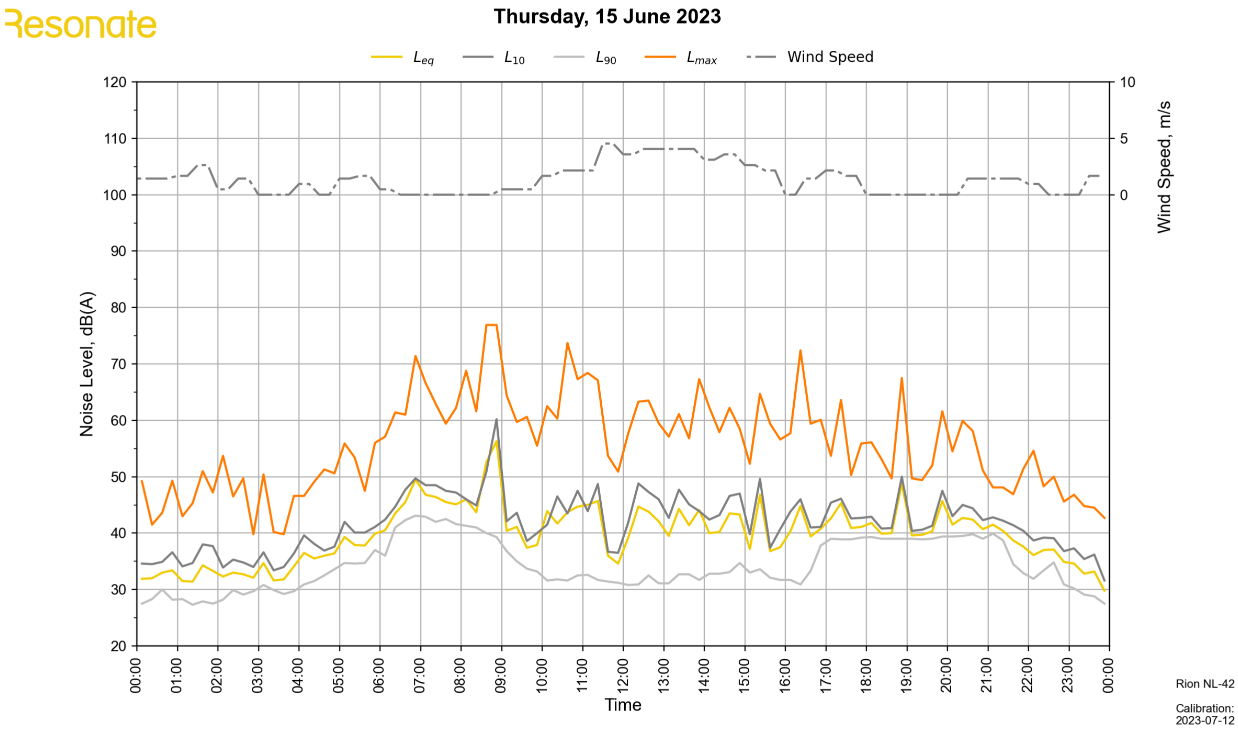

Resonate
Sunday, 11 June 2023
Leq
L10
L90
Lmax
Wind Speed
Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
120
110
100
90
80
70
60
50
40
30
20
10
5
0
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Time
Rion NL-42
Calibration:
2023-07-12

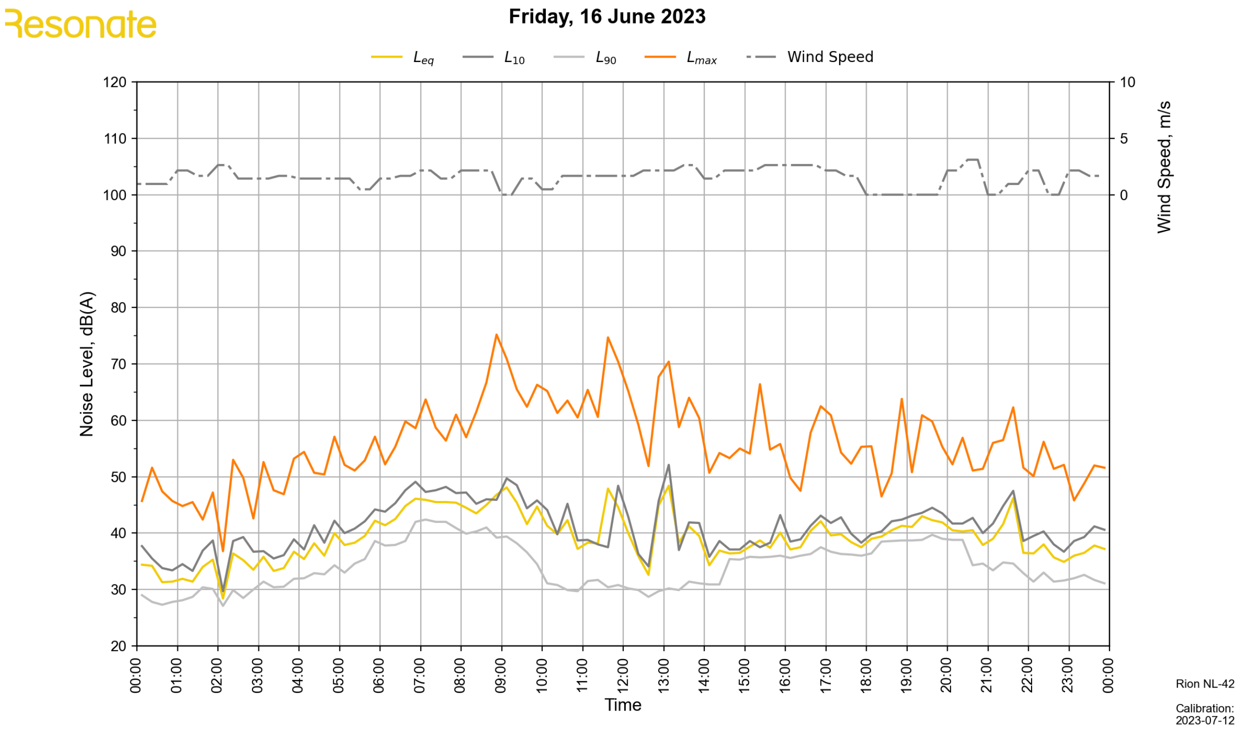
Resonate

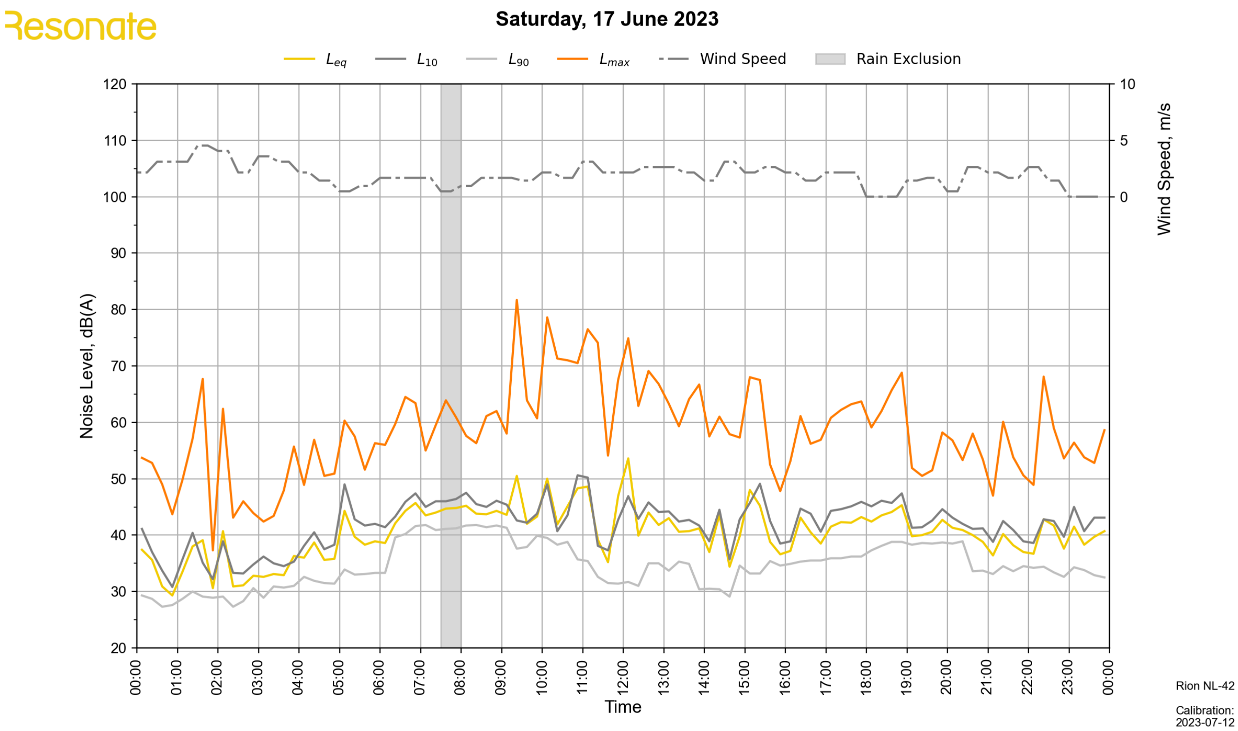

Resonate
Monday, 12 June 2023
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
Calibration:
2023-07-12

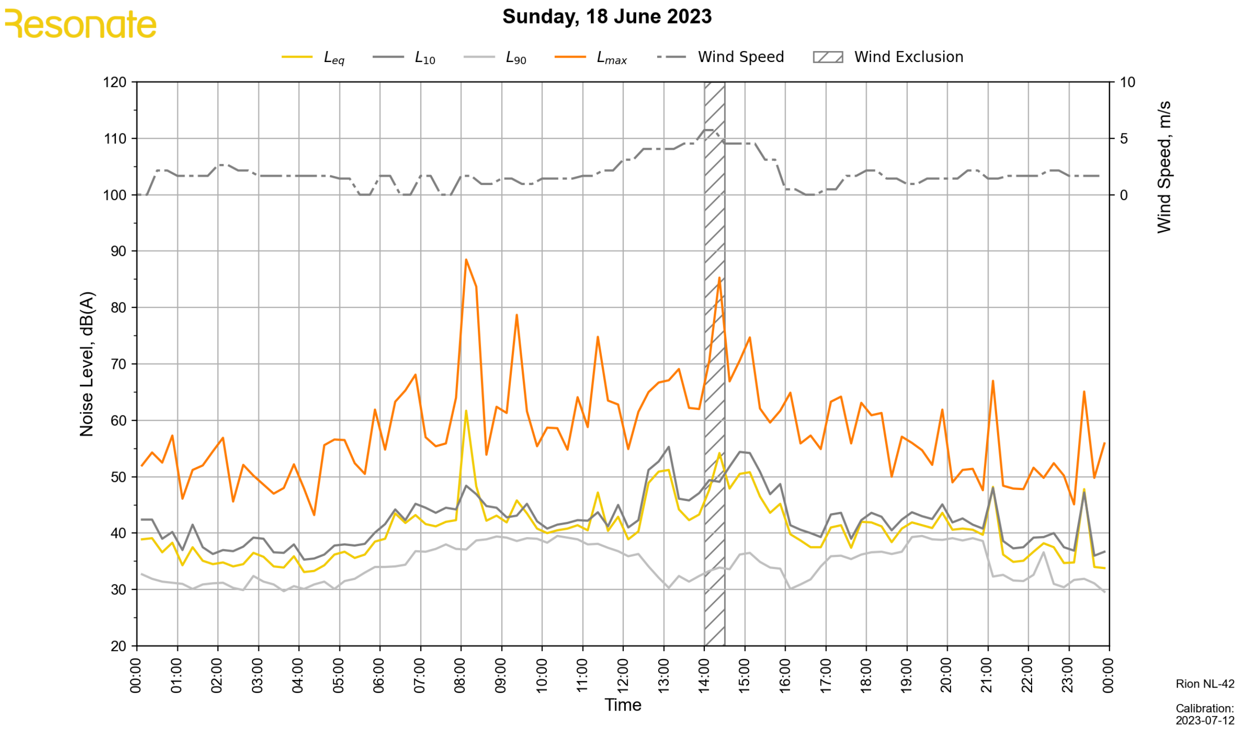

Resonate
Tuesday, 13 June 2023
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Wind Exclusion
Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
Calibration:
2023-07-12

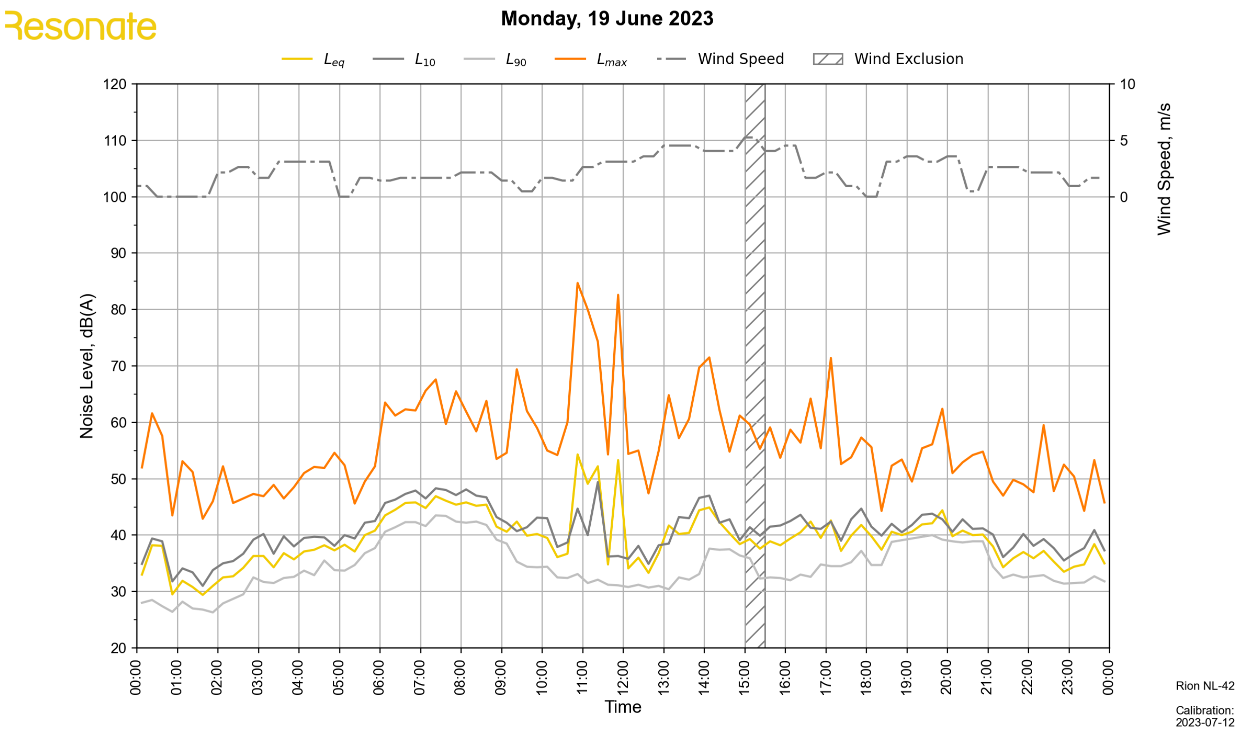

Resonate
Wednesday, 14 June 2023
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Wind Exclusion
Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
Calibration: 2023-07-12


Resonate
Thursday, 15 June 2023
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
Calibration: 2023-07-12

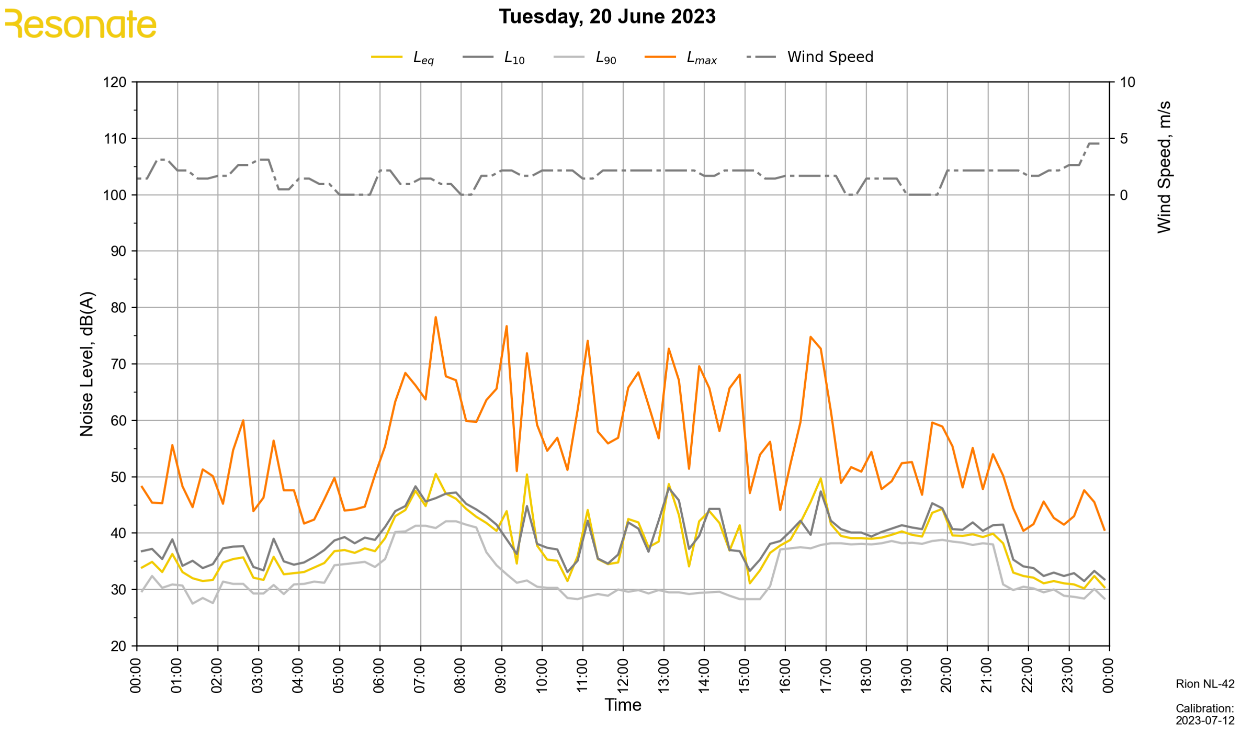

Friday, 16 June 2023
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
Calibration:
2023-07-12

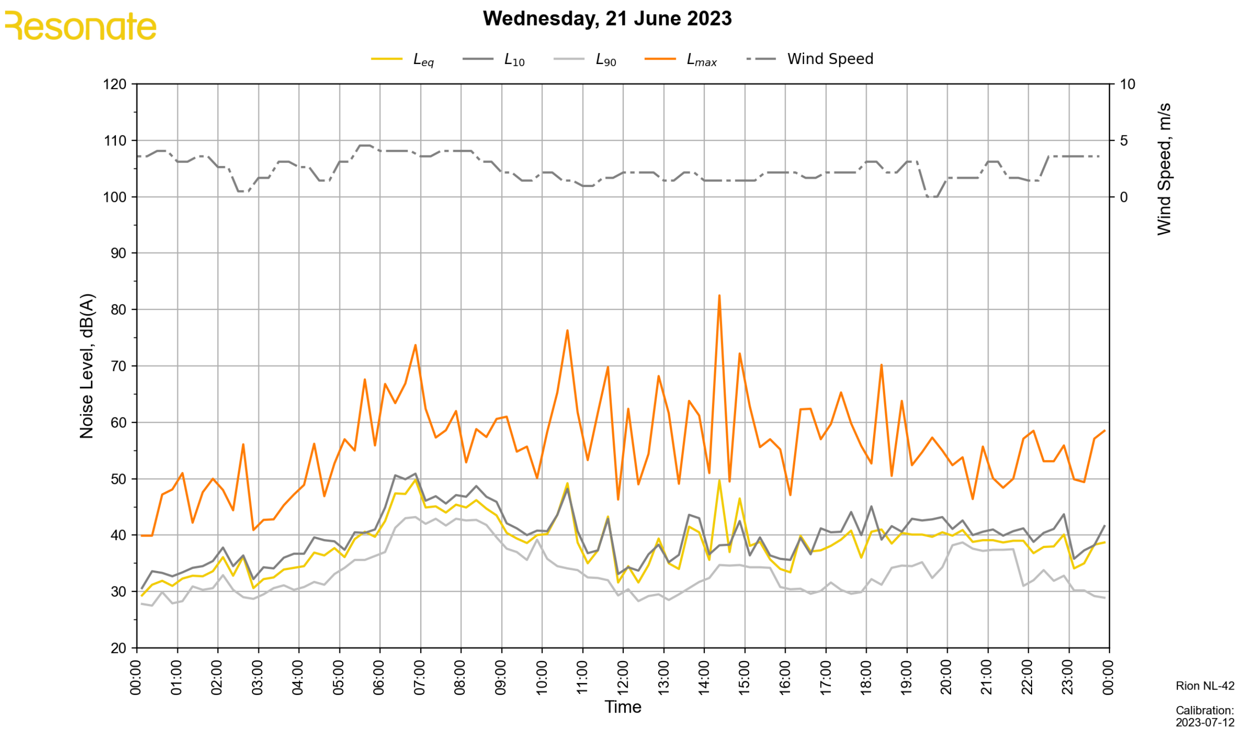

Saturday, 17 June 2023
Leq
L10
L90
Lmax
Wind Speed
Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
Calibration:
2023-07-12

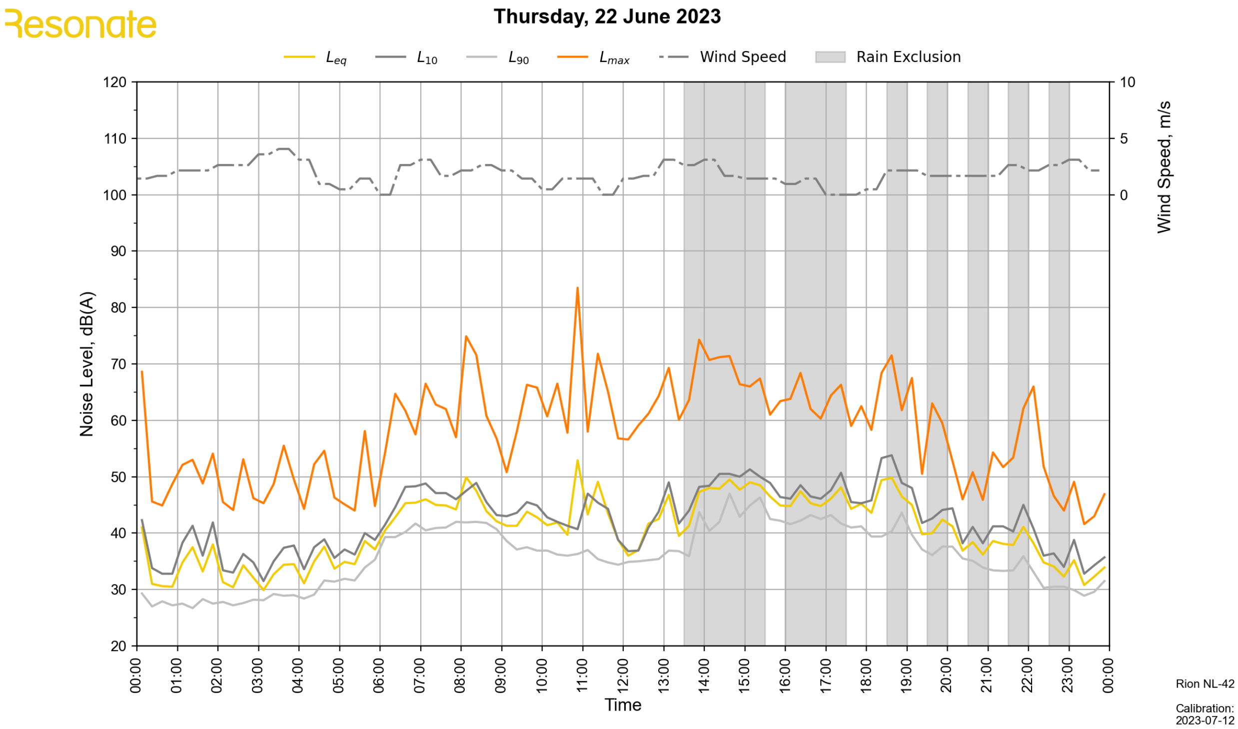

Resonate
Sunday, 18 June 2023
Leq
L10
L90
Lmax
Wind Speed
Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
Calibration: 2023-07-12

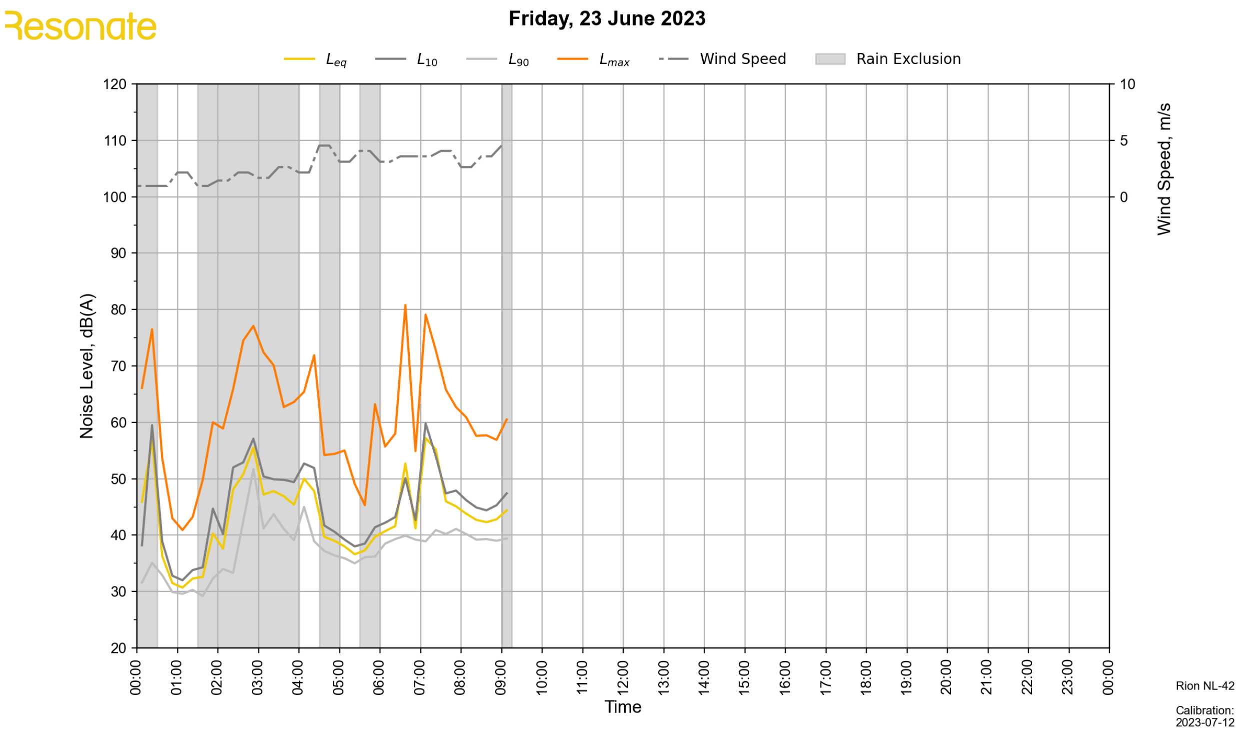

Resonate
Monday, 19 June 2023
Leq
L10
L90
Lmax
Wind Speed
Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
Calibration: 2023-07-12

Resonate

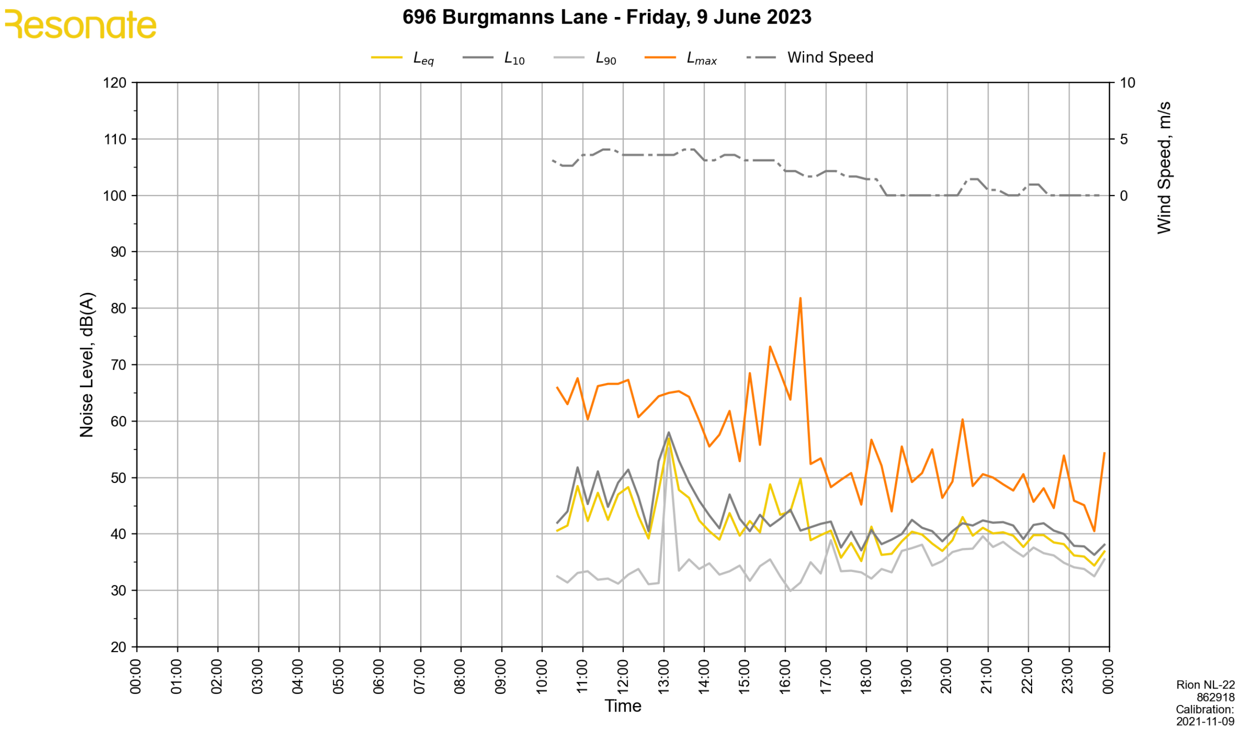

Resonate
Tuesday, 20 June 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
Calibration: 2023-07-12

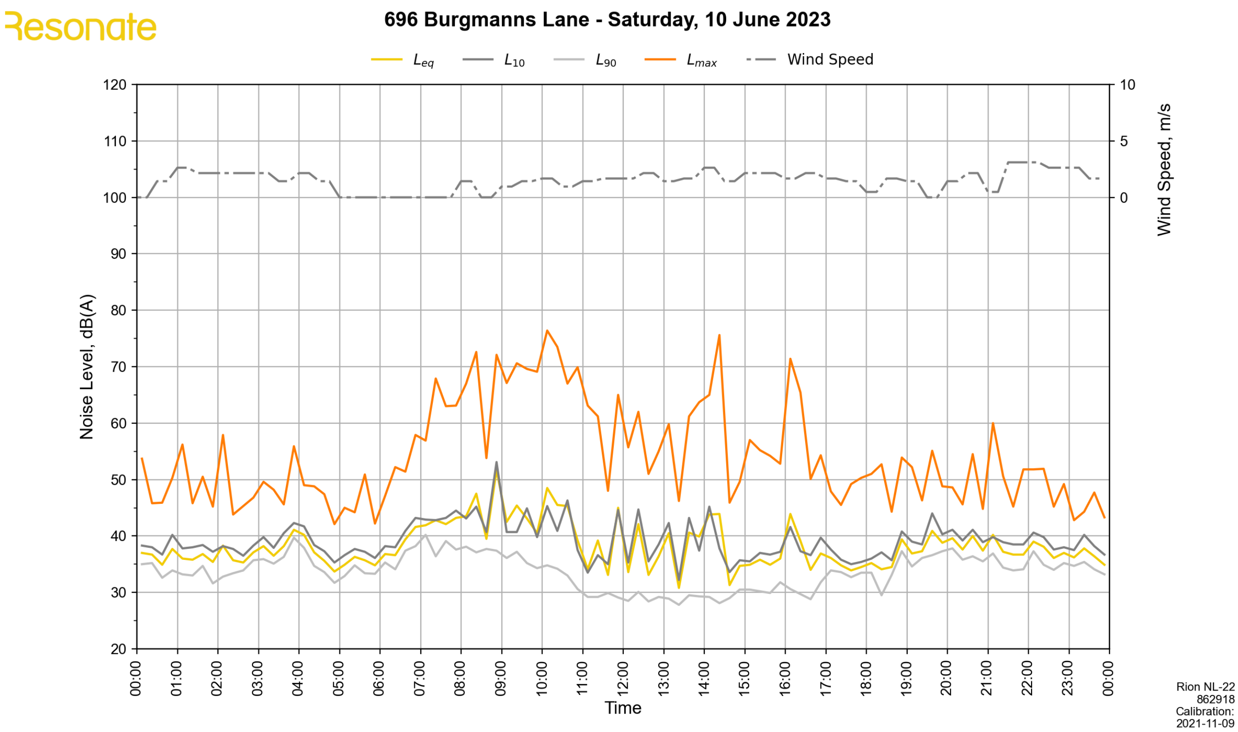

Resonate
Wednesday, 21 June 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
Calibration: 2023-07-12

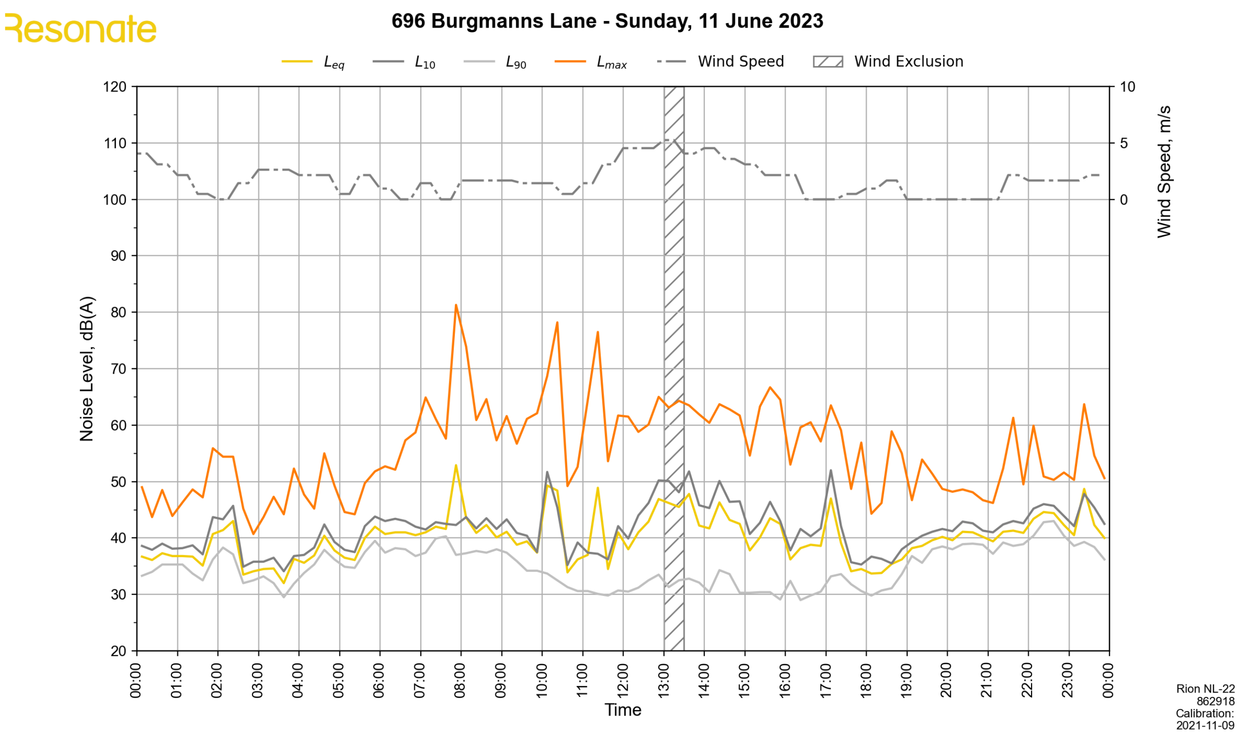

Resonate
Thursday, 22 June 2023
Leq L10 L90 Lmax Wind Speed Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
Calibration: 2023-07-12

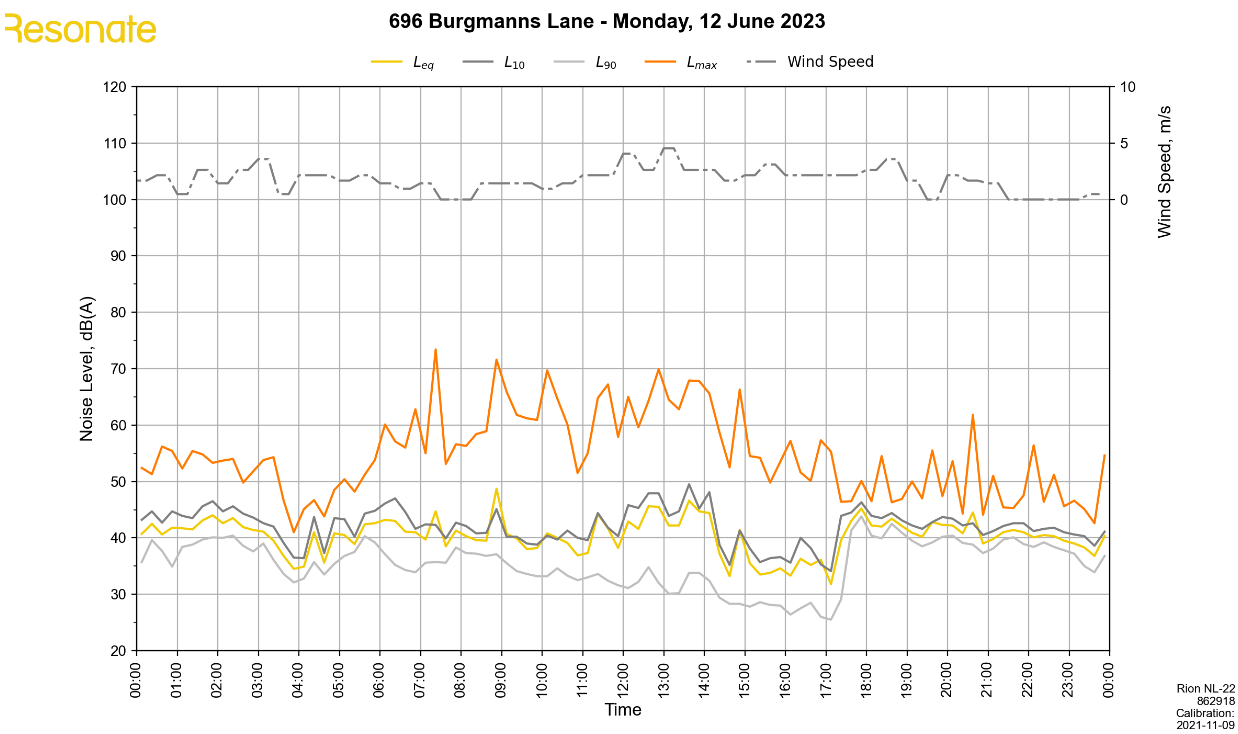

Resonate
Friday, 23 June 2023
Leq L10 L90 Lmax Wind Speed Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
Calibration: 2023-07-12

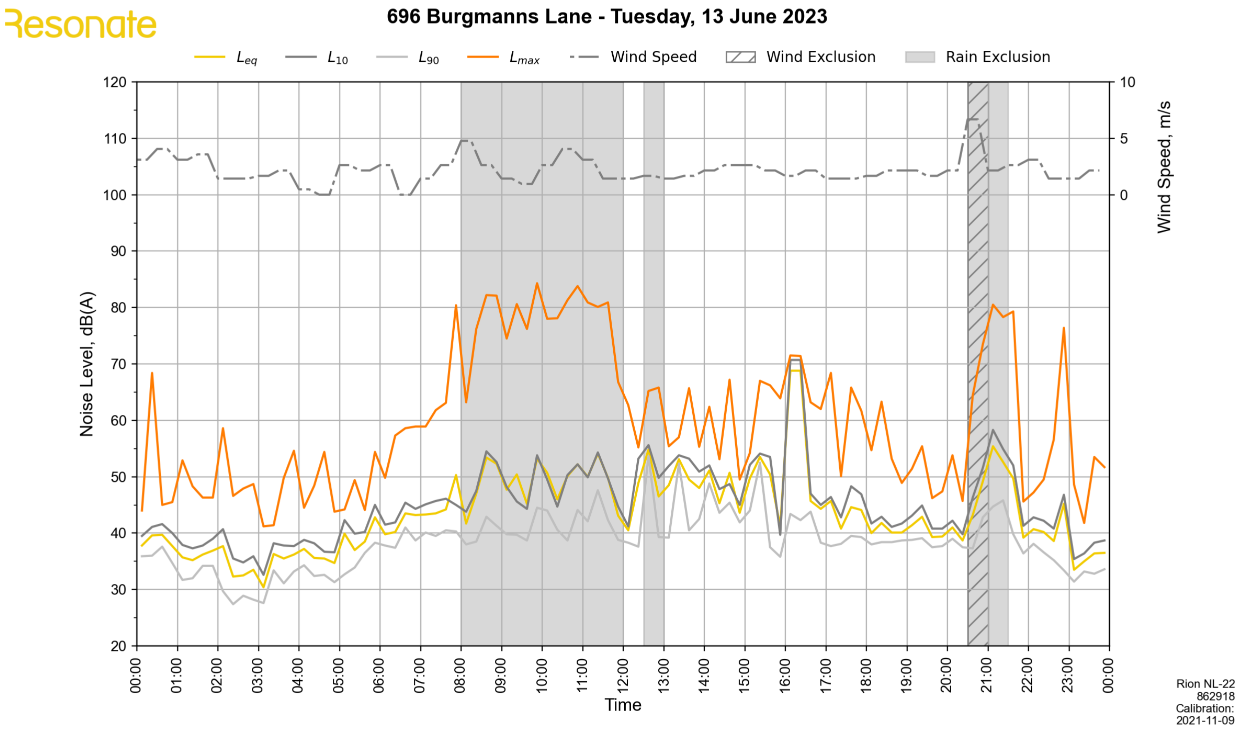
Logger Location 2

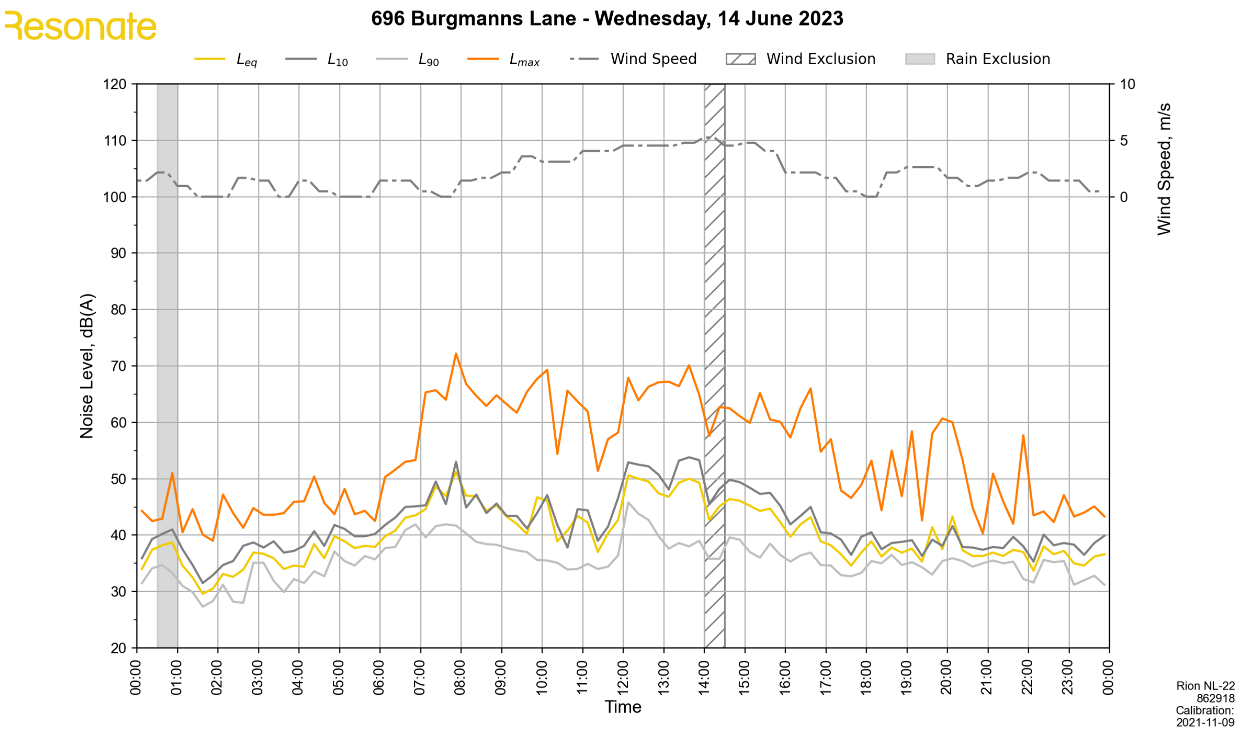




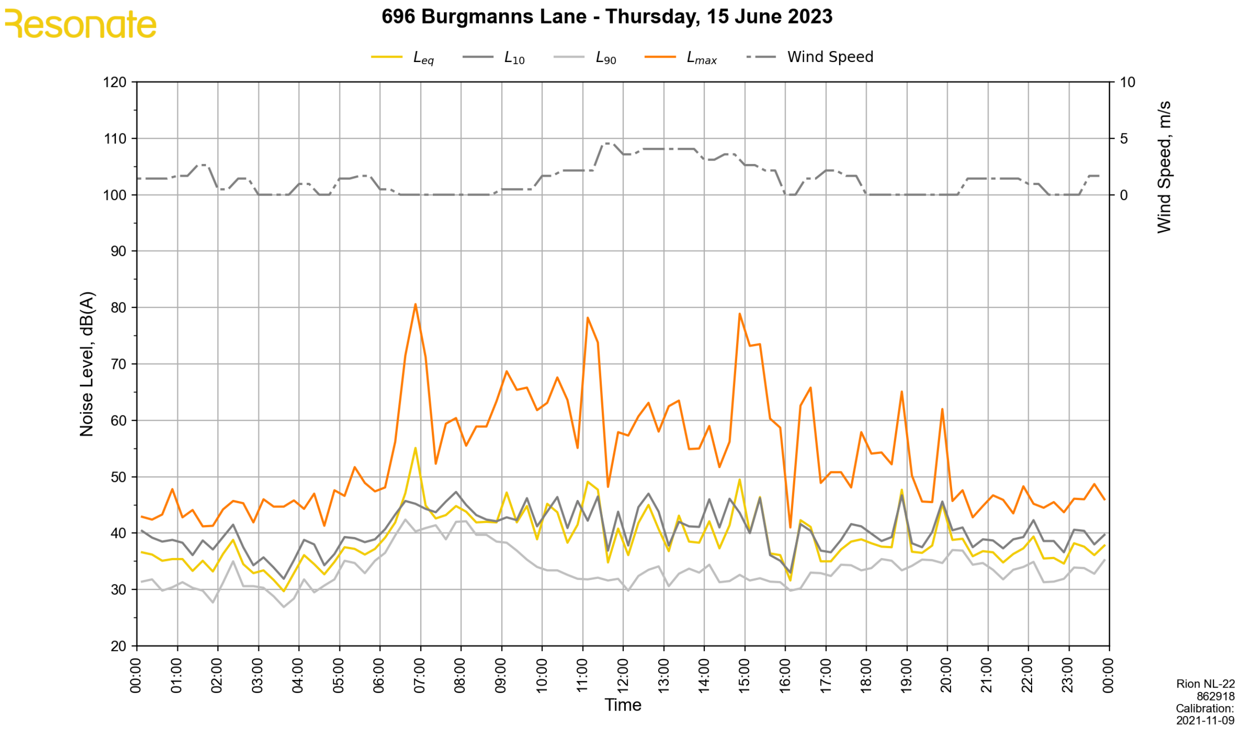

Resonate
696 Burgmanns Lane - Sunday, 11 June 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-22
862918
Calibration:
2021-11-09

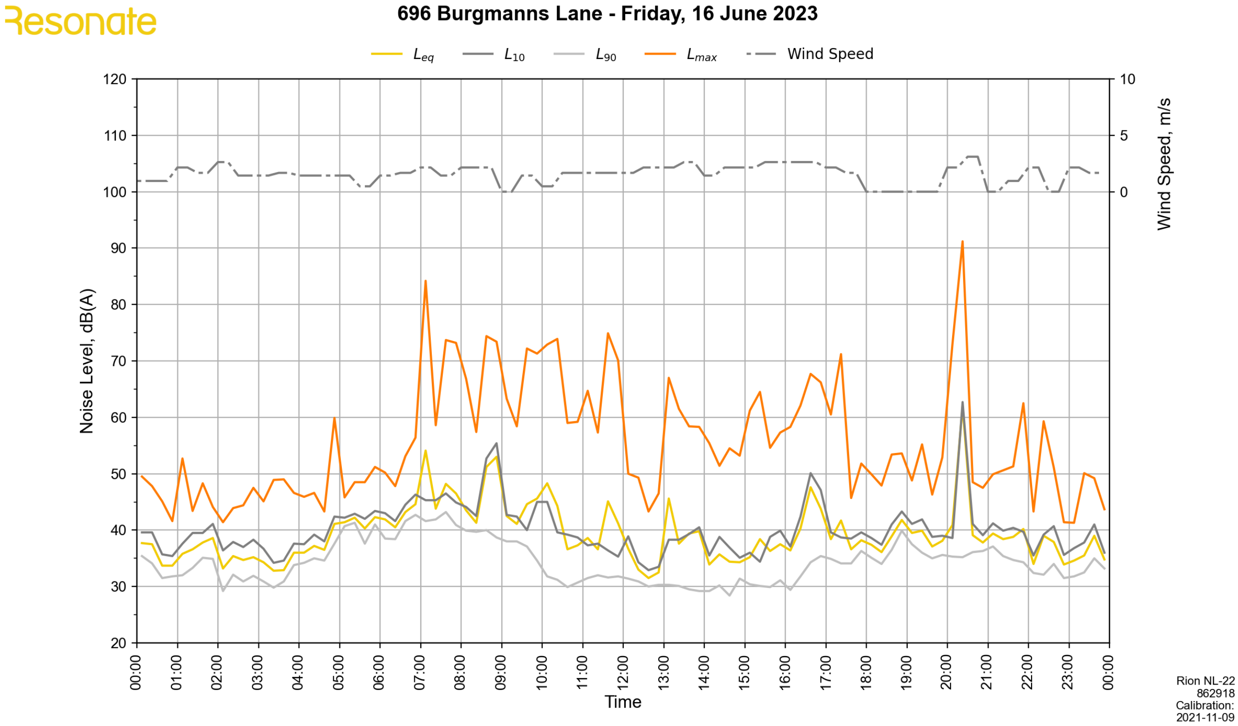

Resonate
696 Burgmanns Lane - Monday, 12 June 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-22
862918
Calibration:
2021-11-09

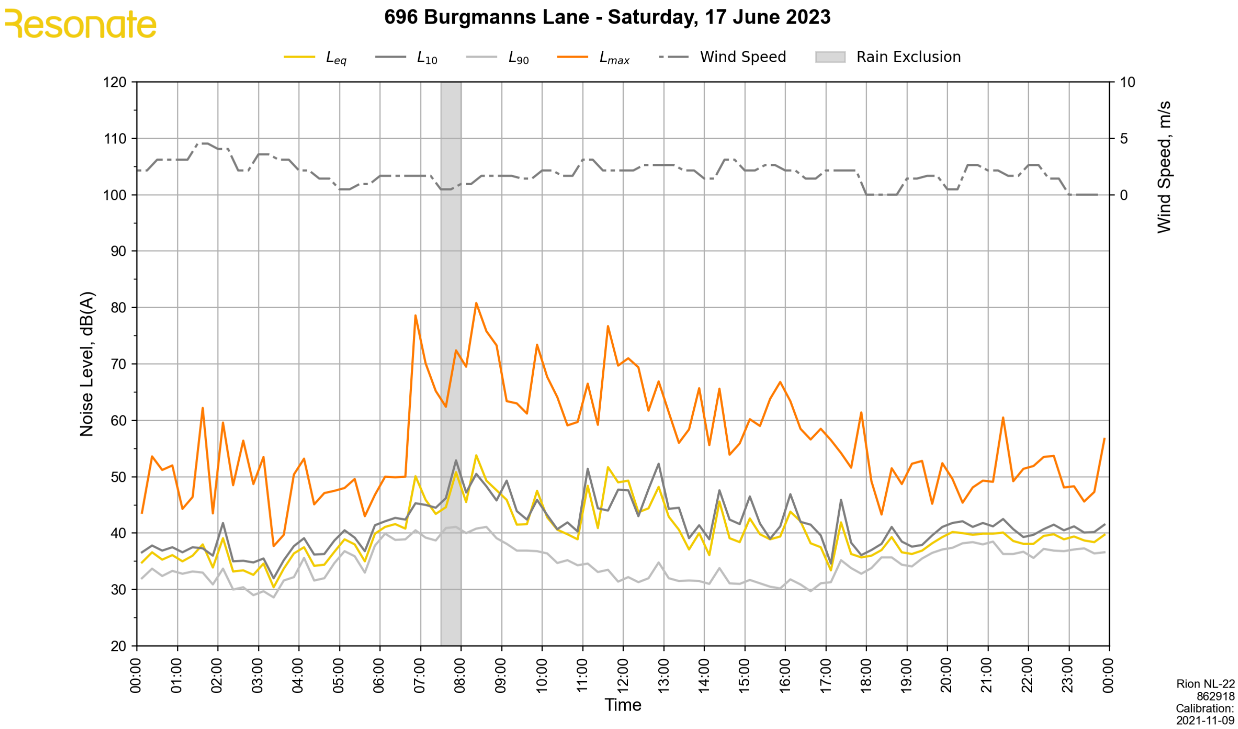

Resonate
696 Burgmanns Lane - Tuesday, 13 June 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-22
862918
Calibration:
2021-11-09

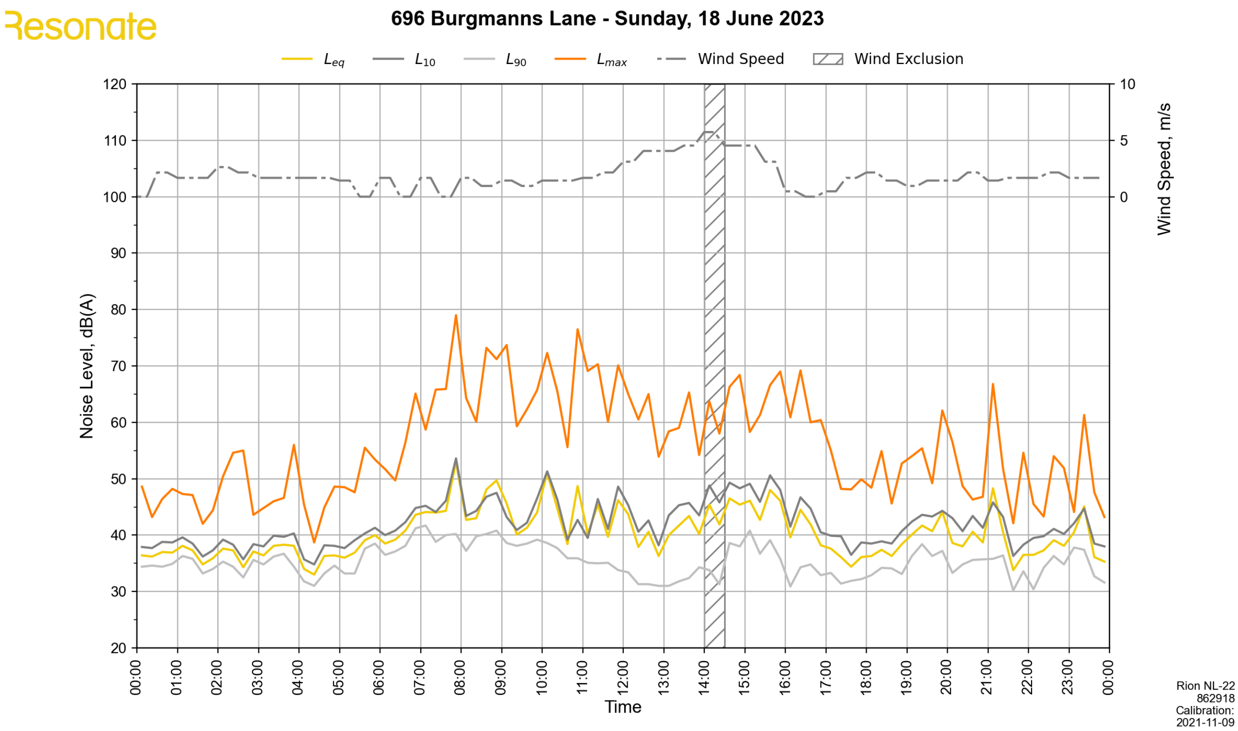

Resonate
696 Burgmanns Lane - Wednesday, 14 June 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed Wind Exclusion Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-22
862918
Calibration:
2021-11-09

Resonate

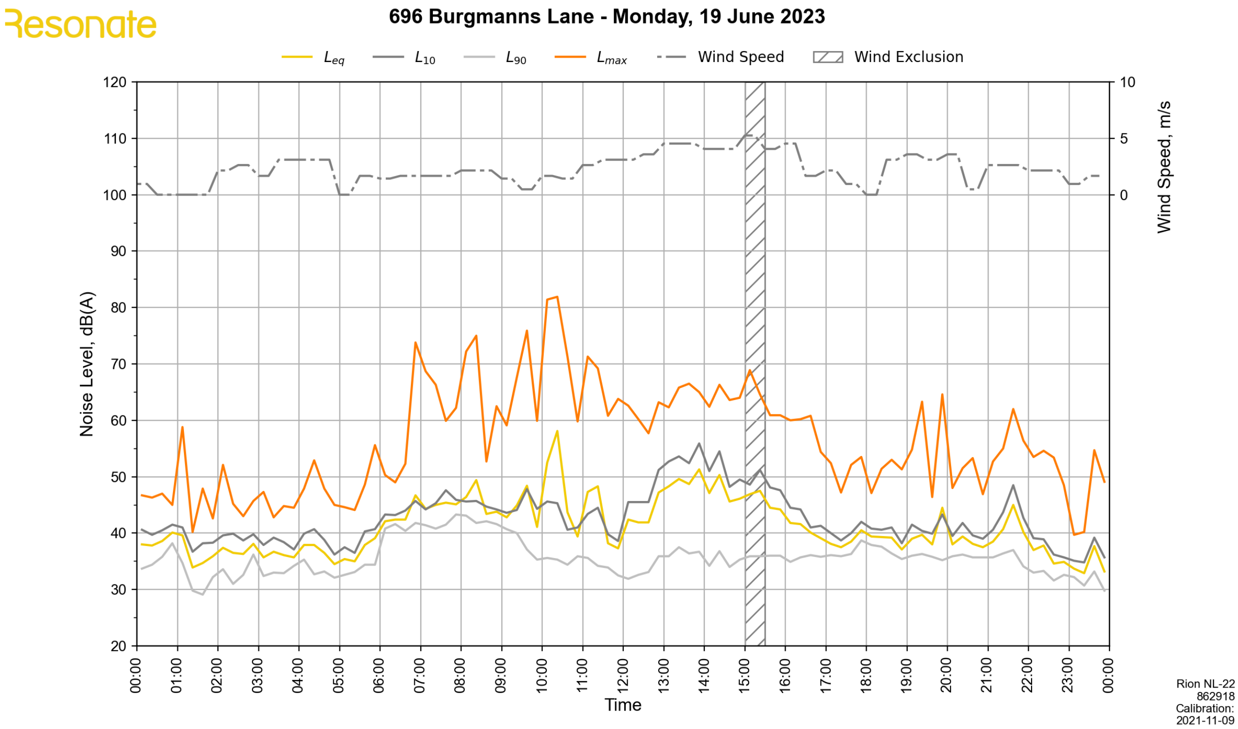

Resonate
696 Burgmanns Lane - Thursday, 15 June 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-22
862918
Calibration:
2021-11-09

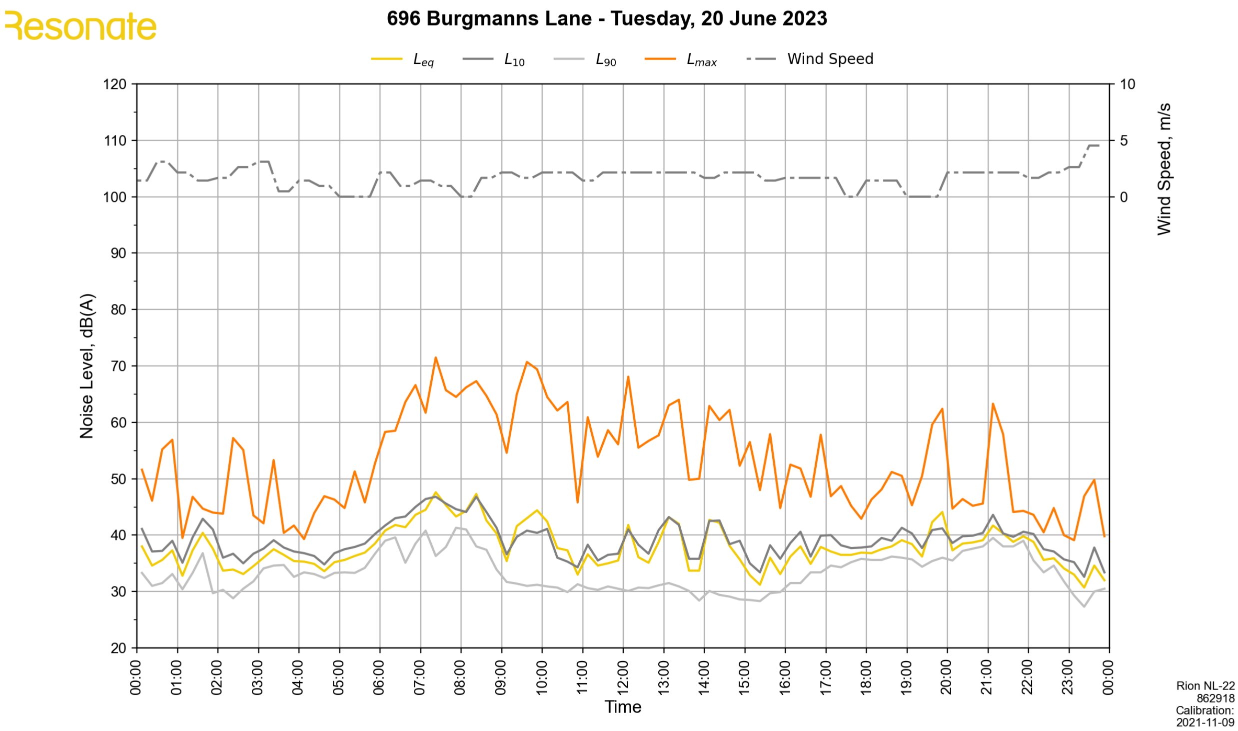

Resonate
696 Burgmanns Lane - Friday, 16 June 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-22
862918
Calibration:
2021-11-09


Resonate
696 Burgmanns Lane - Saturday, 17 June 2023
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-22
862918
Calibration:
2021-11-09

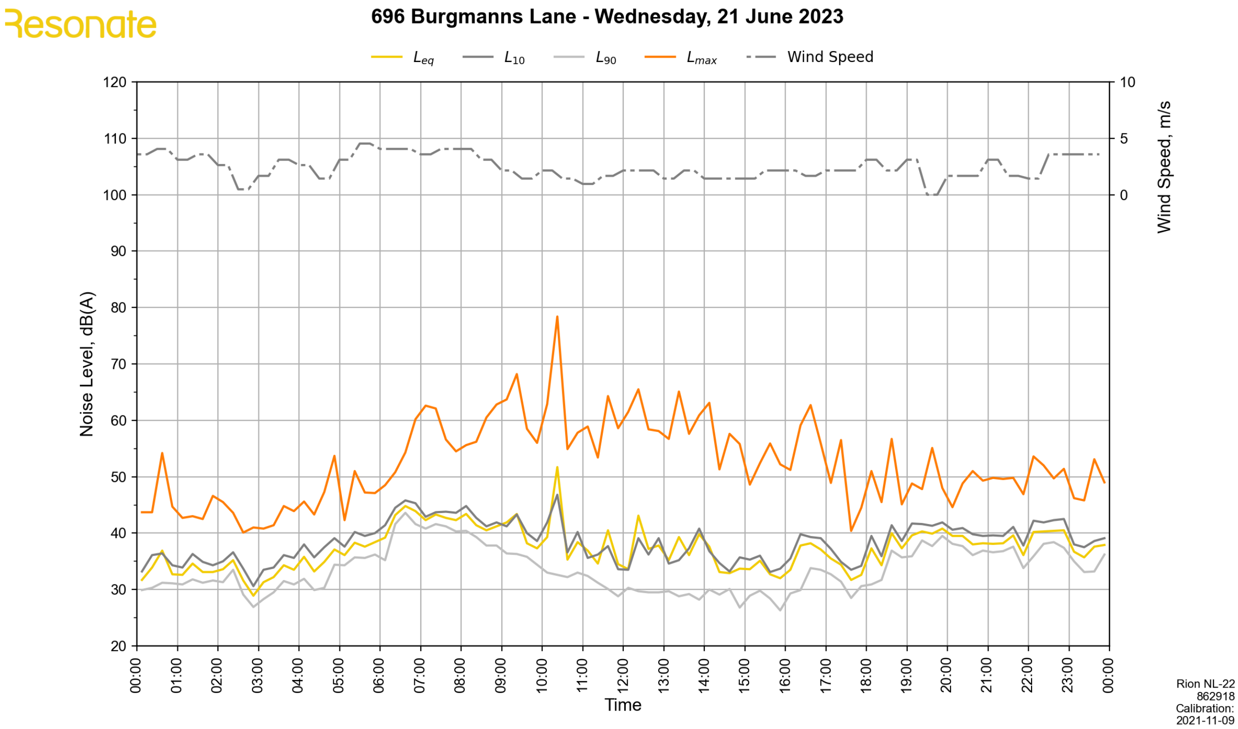

Resonate
696 Burgmanns Lane - Sunday, 18 June 2023
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-22
862918
Calibration:
2021-11-09

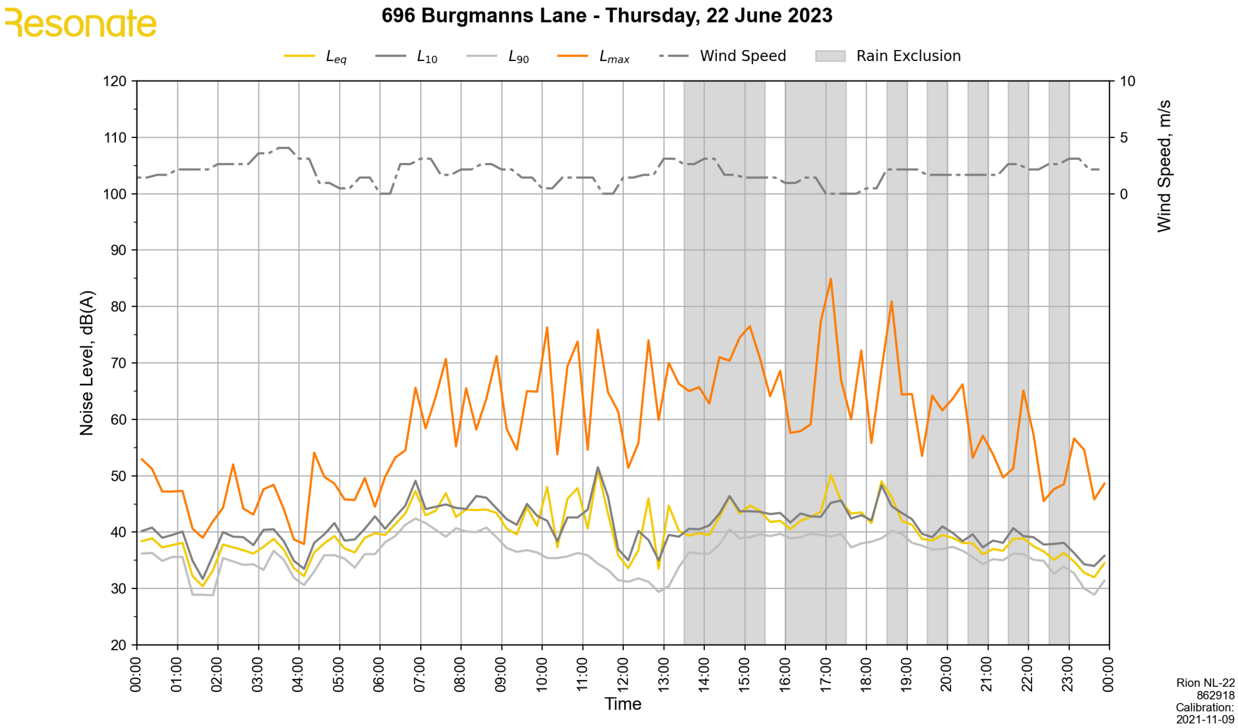
Resonate

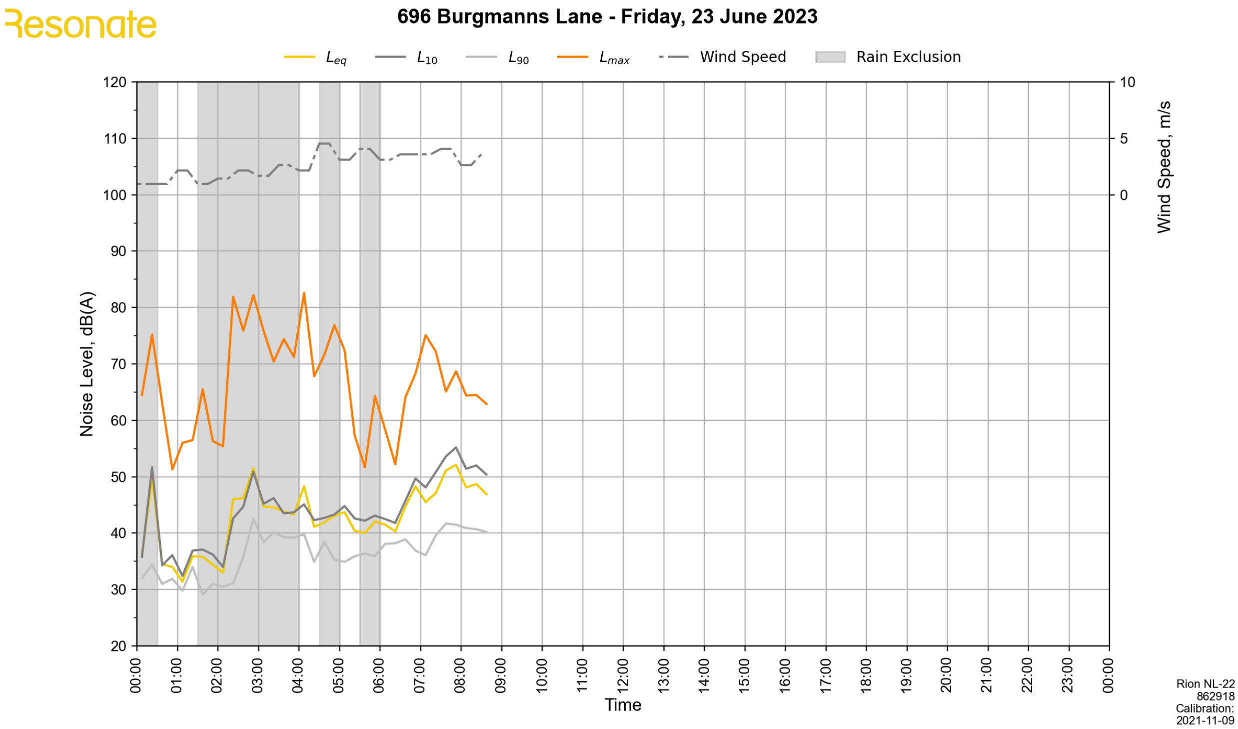

Resonate
696 Burgmanns Lane - Monday, 19 June 2023
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Wind Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-22
862918
Calibration:
2021-11-09


Resonate
696 Burgmanns Lane - Tuesday, 20 June 2023
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-22
862918
Calibration:
2021-11-09

Resonate


Resonate
696 Burgmanns Lane - Wednesday, 21 June 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-22
862918
Calibration:
2021-11-09


Resonate
696 Burgmanns Lane - Thursday, 22 June 2023
L_{eq} L_{10} L_{90} L_{max} Wind Speed Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-22
862918
Calibration:
2021-11-09


696 Burgmanns Lane - Friday, 23 June 2023
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Rain Exclusion
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-22
862918
Calibration:
2021-11-09

Appendix C – Predicted Construction Noise Levels

Receiver ID	Predicted L_{eq} – dB(A)	Standard hours			"Highly Noise Affected"		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
Stage 1A - Site preparation, clearing & demolition							
R01	56	45	11	No	75	0	Yes
R02	53	45	8	No	75	0	Yes
R03	50	45	5	No	75	0	Yes
R04	50	45	5	No	75	0	Yes
R05	51	45	6	No	75	0	Yes
R06	50	45	5	No	75	0	Yes
R07	50	45	5	No	75	0	Yes
R08	50	45	5	No	75	0	Yes
R09	50	45	5	No	75	0	Yes
R10	34	45	0	Yes	75	0	Yes
R11	45	45	0	Yes	75	0	Yes
R12	49	45	4	No	75	0	Yes
R13	49	45	4	No	75	0	Yes
R14	49	45	4	No	75	0	Yes
R15	47	45	2	No	75	0	Yes
R16	48	45	3	No	75	0	Yes
R17	48	45	3	No	75	0	Yes
R18	48	45	3	No	75	0	Yes
R19	48	45	3	No	75	0	Yes
R20	48	45	3	No	75	0	Yes
R21	47	45	2	No	75	0	Yes
R22	47	45	2	No	75	0	Yes
R23	35	45	0	Yes	75	0	Yes
R24	47	45	2	No	75	0	Yes
R25	46	45	1	No	75	0	Yes
R26	46	45	1	No	75	0	Yes
R27	46	45	1	No	75	0	Yes

Resonate

Receiver ID	Predicted L_{eq} – dB(A)	Standard hours			"Highly Noise Affected"		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
R28	46	45	1	No	75	0	Yes
R29	38	45	0	Yes	75	0	Yes
R30	46	45	1	No	75	0	Yes
R31	45	45	0	Yes	75	0	Yes
R32	43	45	0	Yes	75	0	Yes
R33	48	45	3	No	75	0	Yes
Stage 1B – Site establishment							
R01	51	45	6	No	75	0	Yes
R02	48	45	3	No	75	0	Yes
R03	45	45	0	Yes	75	0	Yes
R04	46	45	1	No	75	0	Yes
R05	46	45	1	No	75	0	Yes
R06	46	45	1	No	75	0	Yes
R07	45	45	0	Yes	75	0	Yes
R08	46	45	1	No	75	0	Yes
R09	45	45	0	Yes	75	0	Yes
R10	29	45	0	Yes	75	0	Yes
R11	40	45	0	Yes	75	0	Yes
R12	44	45	0	Yes	75	0	Yes
R13	44	45	0	Yes	75	0	Yes
R14	44	45	0	Yes	75	0	Yes
R15	42	45	0	Yes	75	0	Yes
R16	43	45	0	Yes	75	0	Yes
R17	43	45	0	Yes	75	0	Yes
R18	43	45	0	Yes	75	0	Yes
R19	43	45	0	Yes	75	0	Yes
R20	43	45	0	Yes	75	0	Yes
R21	42	45	0	Yes	75	0	Yes
R22	42	45	0	Yes	75	0	Yes
R23	30	45	0	Yes	75	0	Yes
R24	42	45	0	Yes	75	0	Yes

Receiver ID	Predicted L_{eq} – dB(A)	Standard hours			"Highly Noise Affected"		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
R25	41	45	0	Yes	75	0	Yes
R26	41	45	0	Yes	75	0	Yes
R27	41	45	0	Yes	75	0	Yes
R28	41	45	0	Yes	75	0	Yes
R29	33	45	0	Yes	75	0	Yes
R30	41	45	0	Yes	75	0	Yes
R31	40	45	0	Yes	75	0	Yes
R32	38	45	0	Yes	75	0	Yes
R33	43	45	0	Yes	75	0	Yes
Stage 2 – Delivery of BESS infrastructure							
R01	44	45	0	Yes	75	0	Yes
R02	41	45	0	Yes	75	0	Yes
R03	38	45	0	Yes	75	0	Yes
R04	38	45	0	Yes	75	0	Yes
R05	39	45	0	Yes	75	0	Yes
R06	38	45	0	Yes	75	0	Yes
R07	38	45	0	Yes	75	0	Yes
R08	38	45	0	Yes	75	0	Yes
R09	38	45	0	Yes	75	0	Yes
R10	22	45	0	Yes	75	0	Yes
R11	33	45	0	Yes	75	0	Yes
R12	37	45	0	Yes	75	0	Yes
R13	37	45	0	Yes	75	0	Yes
R14	37	45	0	Yes	75	0	Yes
R15	35	45	0	Yes	75	0	Yes
R16	36	45	0	Yes	75	0	Yes
R17	36	45	0	Yes	75	0	Yes
R18	36	45	0	Yes	75	0	Yes
R19	36	45	0	Yes	75	0	Yes
R20	36	45	0	Yes	75	0	Yes
R21	35	45	0	Yes	75	0	Yes

Receiver ID	Predicted L_{eq} – dB(A)	Standard hours			"Highly Noise Affected"		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
R22	35	45	0	Yes	75	0	Yes
R23	23	45	0	Yes	75	0	Yes
R24	35	45	0	Yes	75	0	Yes
R25	34	45	0	Yes	75	0	Yes
R26	34	45	0	Yes	75	0	Yes
R27	34	45	0	Yes	75	0	Yes
R28	34	45	0	Yes	75	0	Yes
R29	26	45	0	Yes	75	0	Yes
R30	34	45	0	Yes	75	0	Yes
R31	33	45	0	Yes	75	0	Yes
R32	31	45	0	Yes	75	0	Yes
R33	36	45	0	Yes	75	0	Yes
Stage 3A - Installation of BESS infrastructure							
R01	52	45	7	No	75	0	Yes
R02	49	45	4	No	75	0	Yes
R03	46	45	1	No	75	0	Yes
R04	46	45	1	No	75	0	Yes
R05	47	45	2	No	75	0	Yes
R06	46	45	1	No	75	0	Yes
R07	46	45	1	No	75	0	Yes
R08	46	45	1	No	75	0	Yes
R09	46	45	1	No	75	0	Yes
R10	30	45	0	Yes	75	0	Yes
R11	41	45	0	Yes	75	0	Yes
R12	45	45	0	Yes	75	0	Yes
R13	45	45	0	Yes	75	0	Yes
R14	45	45	0	Yes	75	0	Yes
R15	43	45	0	Yes	75	0	Yes
R16	44	45	0	Yes	75	0	Yes
R17	44	45	0	Yes	75	0	Yes
R18	44	45	0	Yes	75	0	Yes

Resonate

Receiver ID	Predicted L_{eq} – dB(A)	Standard hours			"Highly Noise Affected"		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
R19	44	45	0	Yes	75	0	Yes
R20	44	45	0	Yes	75	0	Yes
R21	43	45	0	Yes	75	0	Yes
R22	43	45	0	Yes	75	0	Yes
R23	31	45	0	Yes	75	0	Yes
R24	43	45	0	Yes	75	0	Yes
R25	42	45	0	Yes	75	0	Yes
R26	41	45	0	Yes	75	0	Yes
R27	42	45	0	Yes	75	0	Yes
R28	42	45	0	Yes	75	0	Yes
R29	34	45	0	Yes	75	0	Yes
R30	41	45	0	Yes	75	0	Yes
R31	41	45	0	Yes	75	0	Yes
R32	38	45	0	Yes	75	0	Yes
R33	44	45	0	Yes	75	0	Yes
Stage 3B – Installation of underground cabling							
R01	44	45	0	Yes	75	0	Yes
R02	46	45	1	No	75	0	Yes
R03	42	45	0	Yes	75	0	Yes
R04	46	45	1	No	75	0	Yes
R05	42	45	0	Yes	75	0	Yes
R06	43	45	0	Yes	75	0	Yes
R07	45	45	0	Yes	75	0	Yes
R08	45	45	0	Yes	75	0	Yes
R09	44	45	0	Yes	75	0	Yes
R10	35	45	0	Yes	75	0	Yes
R11	33	45	0	Yes	75	0	Yes
R12	39	45	0	Yes	75	0	Yes
R13	44	45	0	Yes	75	0	Yes
R14	44	45	0	Yes	75	0	Yes
R15	42	45	0	Yes	75	0	Yes

Receiver ID	Predicted L_{eq} – dB(A)	Standard hours			"Highly Noise Affected"		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
R16	40	45	0	Yes	75	0	Yes
R17	40	45	0	Yes	75	0	Yes
R18	40	45	0	Yes	75	0	Yes
R19	42	45	0	Yes	75	0	Yes
R20	43	45	0	Yes	75	0	Yes
R21	42	45	0	Yes	75	0	Yes
R22	39	45	0	Yes	75	0	Yes
R23	26	45	0	Yes	75	0	Yes
R24	41	45	0	Yes	75	0	Yes
R25	40	45	0	Yes	75	0	Yes
R26	38	45	0	Yes	75	0	Yes
R27	40	45	0	Yes	75	0	Yes
R28	40	45	0	Yes	75	0	Yes
R29	26	45	0	Yes	75	0	Yes
R30	39	45	0	Yes	75	0	Yes
R31	40	45	0	Yes	75	0	Yes
R32	33	45	0	Yes	75	0	Yes
R33	42	45	0	Yes	75	0	Yes
Stage 4 – Commissioning and joint testing							
R01	36	45	0	Yes	75	0	Yes
R02	33	45	0	Yes	75	0	Yes
R03	30	45	0	Yes	75	0	Yes
R04	31	45	0	Yes	75	0	Yes
R05	31	45	0	Yes	75	0	Yes
R06	31	45	0	Yes	75	0	Yes
R07	30	45	0	Yes	75	0	Yes
R08	31	45	0	Yes	75	0	Yes
R09	30	45	0	Yes	75	0	Yes
R10	14	45	0	Yes	75	0	Yes
R11	25	45	0	Yes	75	0	Yes
R12	29	45	0	Yes	75	0	Yes

Resonate

Receiver ID	Predicted L_{eq} – dB(A)	Standard hours			"Highly Noise Affected"		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
R13	29	45	0	Yes	75	0	Yes
R14	29	45	0	Yes	75	0	Yes
R15	27	45	0	Yes	75	0	Yes
R16	28	45	0	Yes	75	0	Yes
R17	28	45	0	Yes	75	0	Yes
R18	28	45	0	Yes	75	0	Yes
R19	28	45	0	Yes	75	0	Yes
R20	28	45	0	Yes	75	0	Yes
R21	27	45	0	Yes	75	0	Yes
R22	27	45	0	Yes	75	0	Yes
R23	15	45	0	Yes	75	0	Yes
R24	27	45	0	Yes	75	0	Yes
R25	26	45	0	Yes	75	0	Yes
R26	26	45	0	Yes	75	0	Yes
R27	26	45	0	Yes	75	0	Yes
R28	26	45	0	Yes	75	0	Yes
R29	18	45	0	Yes	75	0	Yes
R30	26	45	0	Yes	75	0	Yes
R31	25	45	0	Yes	75	0	Yes
R32	23	45	0	Yes	75	0	Yes
R33	28	45	0	Yes	75	0	Yes

Appendix D – Construction Noise Contours

Resonate

Appendix E – Construction Road Traffic Noise Calculations

Burgmanns Lane Calculation

Transport
Roads & Maritime
Services

NSW GOVERNMENT

Road Traffic Noise Estimator

Please input information into yellow cells	
Please pick from drop-down list in orange cells	

Ground type	Undeveloped green fields (rural areas with isolated dwellings)	
Road surface	DGA	
Road type	Local road	Note that a road is new if a road's functional class changes during construction. For example, rerouting traffic from an arterial road temporarily to a collector road changes the functional class of the collector road for the duration of the temporary reroute.
	Day	Night
Noise criteria (residences)	55	50
Existing speed	80	80
Speed during construction	80	80

	Day (7am to 10pm)		Night (10pm to 7am)		Worst Case 1-hour Day		Worst Case 1-hour Night	
Existing traffic	Light vehicles	Heavy vehicles	Light vehicles	Heavy vehicles	Light vehicles	Heavy vehicles	Light vehicles	Heavy vehicles
Direction (1)	[redacted]	[redacted]	[redacted]	[redacted]	17	6	1	1
Direction (2)	[redacted]	[redacted]	[redacted]	[redacted]	17	6	1	1
Additional traffic	[redacted]							
Direction (1)	[redacted]	[redacted]	[redacted]	[redacted]	8	1	0	0
Direction (2)	[redacted]	[redacted]	[redacted]	[redacted]	8	1	0	0

	Day	Night
Change in noise levels (dBA)	1.0	0.0
Mitigation level (dBA)	55	50
Is the change in noise level greater than 2.0 dBA?	No	No
Require consideration of additional mitigation measures?	No	No
Mitigation distance (m)		

To assess noise impacts from construction traffic or a temporary reroute due to a road closure or both an initial screening test should be undertaken by evaluating whether noise levels will increase by more than 2dB(A). Where increases are 2dBA or less then no further assessment is required. Where noise levels increase by more than 2dBA (2.1dBA) and noise levels exceed the controlling criterion then the receiver qualifies for consideration of noise mitigation under the Noise Mitigation Guideline. [note: the assessment methodology is similar to minor works so in any instance the only trigger for noise mitigation under the NMG shall be due to noise level increase]

Mitigation Measures
Management of construction related traffic or traffic reroutes noise should as a minimum include the following controls:
- Scheduling and routing of vehicle movements
- Speed of vehicles
- Driver behaviour and avoidance of the use of engine compression brakes
- Ensuring vehicles are adequately silenced before allowing them to access the site

Where noise impacts are greater than one year then consideration should be given to the following measures where feasible and reasonable:
- temporary noise barriers
- at-receiver noise mitigation

Feasible and reasonable considerations should also include:
- time of day of the noise increase and exceedance of criteria
- time of use of affected receivers
- how many decibels the noise levels are to increase
- how long the mitigation will provide benefit to the receiver during the project

Calculating noise level at the receiver

Distance to receiver (m)		
Direction (1)	20	
Direction (2)	20	
	Day	Night
Predicted noise levels (dBA) @ 1m from the façade	58.5	50.5

Note:
(1) Noise reports present noise levels rounded to the nearest integer and differences between two noise levels rounded to a single decimal place.
(2) noise barriers more than 3 metres high, if designed using Roads and Maritime guidelines, would generally provide an insertion loss of around 5 dB(A) at the most affected residence.
(3) noise barriers more than 5 metres high, if designed using Roads and Maritime guidelines, would generally provide an insertion loss of around 10 dB(A) at the most affected residence.

Resonate

New England Highway Calculation

Transport Roads & Maritime Services

NSW GOVERNMENT

Road Traffic Noise Estimator

Please input information into yellow cells
Please pick from drop-down list in orange cells

Ground type	Undeveloped green fields (rural areas with isolated dwellings)	
Road surface	DGA	
Road type	Freeway/arterial/sub-arterial road	
	Day	**Night**
Noise criteria (residences)	60	55
Existing speed	80	80
Speed during construction	80	80

Note that a road is new if a road's functional class changes during construction. For example, rerouting traffic from an arterial road temporarily to a collector road changes the functional class of the collector road for the duration of the temporary reroute.

	Day (7am to 10pm)		Night (10pm to 7am)		Worst Case 1-hour Day		Worst Case 1-hour Night	
Existing traffic	**Light vehicles**	**Heavy vehicles**	**Light vehicles**	**Heavy vehicles**	**Light vehicles**	**Heavy vehicles**	**Light vehicles**	**Heavy vehicles**
Direction (1)	1541	272	1	1	[redacted]	[redacted]	[redacted]	[redacted]
Direction (2)	1541	272	1	1	[redacted]	[redacted]	[redacted]	[redacted]
Additional traffic								
Direction (1)	80	10	0	0	[redacted]	[redacted]	[redacted]	[redacted]
Direction (2)	80	10	0	0	[redacted]	[redacted]	[redacted]	[redacted]

	Day	Night
Change in noise levels (dBA)	0.2	0.0
Mitigation level (dBA)	60	55
Is the change in noise level greater than 2.0 dBA?	No	No
Require consideration of additional mitigation measures?	No	No
Mitigation distance (m)		

To assess noise impacts from construction traffic or a temporary reroute due to a road closure or both an initial screening test should be undertaken by evaluating whether noise levels will increase by more than 2dB(A). Where increases are 2dBA or less then no further assessment is required. Where noise levels increase by more than 2dBA (2.1dBA) and noise levels exceed the controlling criterion then the receiver qualifies for consideration of noise mitigation under the Noise Mitigation Guideline. [note: the assessment methodology is similar to minor works so in any instance the only trigger for noise mitigation under the NMG shall be due to noise level increase]

Mitigation Measures
Management of construction related traffic or traffic reroutes noise should as a minimum include the following controls:
- Scheduling and routing of vehicle movements
- Speed of vehicles
- Driver behaviour and avoidance of the use of engine compression brakes
- Ensuring vehicles are adequately silenced before allowing them to access the site

Where noise impacts are greater than one year then consideration should be given to the following measures where feasible and reasonable:
- temporary noise barriers
- at-receiver noise mitigation

Feasible and reasonable considerations should also include:
- time of day of the noise increase and exceedance of criteria
- time of use of affected receivers
- how many decibels the noise levels are to increase
- how long the mitigation will provide benefit to the receiver during the project

Calculating noise level at the receiver

Distance to receiver (m)		
Direction (1)	20	
Direction (2)	20	
	Day	**Night**
Predicted noise levels (dBA) @ 1m from the façade	63.6	41.0

Note:
(1) Noise reports present noise levels rounded to the nearest integer and differences between two noise levels rounded to a single decimal place.
(2) noise barriers more than 3 metres high, if designed using Roads and Maritime guidelines, would generally provide an insertion loss of around 5 dB(A) at the most affected residence.
(3) noise barriers more than 5 metres high, if designed using Roads and Maritime guidelines, would generally provide an insertion loss of around 10 dB(A) at the most affected residence.

Resonate

Appendix F – Predicted Operational Noise Levels

Operation at 100% duty during neutral weather condition

Receiver ID	Daytime period				Evening period				Night-time period			
	Predicted(1) dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)	Predicted(1) dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)	Predicted(1) dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)
R01	53	40	13	No	53	39	14	No	53	35	18	No
R02	49	40	9	No	49	39	10	No	49	35	14	No
R03	44	40	4	No	44	39	5	No	44	35	9	No
R04	45	40	5	No	45	39	6	No	45	35	10	No
R05	46	40	6	No	46	39	7	No	46	35	11	No
R06	46	40	6	No	46	39	7	No	46	35	11	No
R07	45	40	5	No	45	39	6	No	45	35	10	No
R08	45	40	5	No	45	39	6	No	45	35	10	No
R09	45	40	5	No	45	39	6	No	45	35	10	No
R10	22	40	0	Yes	22	39	0	Yes	22	35	0	Yes
R11	32	40	0	Yes	32	39	0	Yes	32	35	0	Yes
R12	40	40	0	Yes	40	39	1	Yes	40	35	5	No
R13	43	40	3	No	43	39	4	No	43	35	8	No
R14	40	40	0	Yes	40	39	1	Yes	40	35	5	No
R15	42	40	2	Yes	42	39	3	No	42	35	7	No

Receiver ID	Daytime period				Evening period				Night-time period			
	Predicted(1) dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance ? (Yes / No)	Predicted(1) dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance ? (Yes / No)	Predicted(1) dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance ? (Yes / No)
R16	44	40	4	No	44	39	5	No	44	35	9	No
R17	42	40	2	Yes	42	39	3	No	42	35	7	No
R18	40	40	0	Yes	40	39	1	Yes	40	35	5	No
R19	42	40	2	Yes	42	39	3	No	42	35	7	No
R20	43	40	3	No	43	39	4	No	43	35	8	No
R21	41	40	1	Yes	41	39	2	Yes	41	35	6	No
R22	41	40	1	Yes	41	39	2	Yes	41	35	6	No
R23	40	40	0	Yes	40	39	1	Yes	40	35	5	No
R24	23	40	0	Yes	23	39	0	Yes	23	35	0	Yes
R25	40	40	0	Yes	40	39	1	Yes	40	35	5	No
R26	41	40	1	Yes	41	39	2	Yes	41	35	6	No
R27	39	40	0	Yes	39	39	0	Yes	39	35	4	No
R28	36	40	0	Yes	36	39	0	Yes	36	35	1	Yes
R29	36	40	0	Yes	36	39	0	Yes	36	35	1	Yes
R30	24	40	0	Yes	24	39	0	Yes	24	35	0	Yes
R31	40	40	0	Yes	40	39	1	Yes	40	35	5	No
R32	38	40	0	Yes	38	39	0	Yes	38	35	3	No
R33	24	40	0	Yes	24	39	0	Yes	24	35	0	Yes

(1) Predicted noise levels include a +5 dB penalty to account for tonal noise characteristics from the Project.

(2) Negligible exceedances of 1 to 2 dB have been considered to achieve compliance with the criteria as 1 to 2 dB exceedances would not be discernible by the average human ear.

Operation at 100% duty during noise enhancing weather conditions

Receiver ID	Daytime period				Evening period				Night-time period			
	Predicted(1) dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance ? (Yes / No)	Predicted(1) dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance ? (Yes / No)	Predicted(1) dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance ? (Yes / No)
R01	57	40	17	No	57	39	18	No	57	35	22	No
R02	53	40	13	No	53	39	14	No	53	35	18	No
R03	48	40	8	No	48	39	9	No	48	35	13	No
R04	49	40	9	No	49	39	10	No	50	35	15	No
R05	50	40	10	No	50	39	11	No	51	35	16	No
R06	50	40	10	No	50	39	11	No	50	35	15	No
R07	49	40	9	No	49	39	10	No	49	35	14	No
R08	50	40	10	No	50	39	11	No	50	35	15	No
R09	50	40	10	No	50	39	11	No	50	35	15	No
R10	27	40	0	Yes	27	39	0	Yes	27	35	0	Yes
R11	37	40	0	Yes	37	39	0	Yes	37	35	2	Yes
R12	44	40	4	No	44	39	5	No	45	35	10	No
R13	47	40	7	No	47	39	8	No	47	35	12	No
R14	44	40	4	No	44	39	5	No	45	35	10	No
R15	47	40	7	No	47	39	8	No	47	35	12	No

Resonate

Receiver ID	Daytime period				Evening period				Night-time period			
	Predicted[(1)] dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance ? (Yes / No)	Predicted[(1)] dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance ? (Yes / No)	Predicted[(1)] dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance ? (Yes / No)
R16	48	40	8	No	48	39	9	No	49	35	14	No
R17	47	40	7	No	47	39	8	No	48	35	13	No
R18	45	40	5	No	45	39	6	No	45	35	10	No
R19	47	40	7	No	47	39	8	No	48	35	13	No
R20	47	40	7	No	47	39	8	No	48	35	13	No
R21	46	40	6	No	46	39	7	No	46	35	11	No
R22	45	40	5	No	45	39	6	No	46	35	11	No
R23	45	40	5	No	45	39	6	No	45	35	10	No
R24	28	40	0	Yes	28	39	0	Yes	29	35	0	Yes
R25	45	40	5	No	45	39	6	No	45	35	10	No
R26	45	40	5	No	45	39	6	No	46	35	11	No
R27	44	40	4	No	44	39	5	No	45	35	10	No
R28	41	40	1	Yes	41	39	2	Yes	42	35	7	No
R29	40	40	0	Yes	40	39	1	Yes	41	35	6	No
R30	28	40	0	Yes	28	39	0	Yes	29	35	0	Yes
R31	44	40	4	No	44	39	5	No	45	35	10	No
R32	43	40	3	No	43	39	4	No	43	35	8	No
R33	28	40	0	Yes	28	39	0	Yes	29	35	0	Yes

(1) Predicted noise levels include a +5 dB penalty to account for tonal noise characteristics from the Project.

(2) Negligible exceedances of 1 to 2 dB have been considered to achieve compliance with the criteria as 1 to 2 dB exceedances would not be discernible by the average human ear.

Appendix G – Operational Noise Contours

Resonate

Appendix H – Predicted Operational Noise Levels with Noise Mitigation

100% duty factor operations during noise enhancing weather conditions with noise mitigation measures

Receiver ID	Daytime period at 100% duty factor				Evening period at 100% duty factor				Night-time period at 100% duty factor			
	Predicted(1) dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)	Predicted(1) dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)	Predicted(1) dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)
R01	41	40	1	Yes	41	39	2	Yes	42(3)	35	7(3)	No(3)
R02	37	40	0	Yes	37	39	0	Yes	37	35	2	Yes
R03	32	40	0	Yes	32	39	0	Yes	32	35	0	Yes
R04	36	40	0	Yes	36	39	0	Yes	36	35	1	Yes
R05	34	40	0	Yes	34	39	0	Yes	35	35	0	Yes
R06	34	40	0	Yes	34	39	0	Yes	34	35	0	Yes
R07	35	40	0	Yes	35	39	0	Yes	36	35	1	Yes
R08	36	40	0	Yes	36	39	0	Yes	37	35	2	Yes
R09	34	40	0	Yes	34	39	0	Yes	35	35	0	Yes
R10	15	40	0	Yes	15	39	0	Yes	16	35	0	Yes
R11	23	40	0	Yes	23	39	0	Yes	23	35	0	Yes
R12	28	40	0	Yes	28	39	0	Yes	29	35	0	Yes
R13	33	40	0	Yes	33	39	0	Yes	34	35	0	Yes
R14	28	40	0	Yes	28	39	0	Yes	29	35	0	Yes
R15	33	40	0	Yes	33	39	0	Yes	34	35	0	Yes

Receiver ID	Daytime period at 100% duty factor				Evening period at 100% duty factor				Night-time period at 100% duty factor			
	Predicted[(1)] dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance ? (Yes / No)	Predicted[(1)] dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance ? (Yes / No)	Predicted[(1)] dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance ? (Yes / No)
R16	34	40	0	Yes	34	39	0	Yes	35	35	0	Yes
R17	31	40	0	Yes	31	39	0	Yes	32	35	0	Yes
R18	29	40	0	Yes	29	39	0	Yes	29	35	0	Yes
R19	31	40	0	Yes	31	39	0	Yes	31	35	0	Yes
R20	33	40	0	Yes	33	39	0	Yes	33	35	0	Yes
R21	32	40	0	Yes	32	39	0	Yes	33	35	0	Yes
R22	32	40	0	Yes	32	39	0	Yes	32	35	0	Yes
R23	29	40	0	Yes	29	39	0	Yes	30	35	0	Yes
R24	16	40	0	Yes	16	39	0	Yes	16	35	0	Yes
R25	32	40	0	Yes	32	39	0	Yes	32	35	0	Yes
R26	32	40	0	Yes	32	39	0	Yes	32	35	0	Yes
R27	28	40	0	Yes	28	39	0	Yes	29	35	0	Yes
R28	28	40	0	Yes	28	39	0	Yes	29	35	0	Yes
R29	28	40	0	Yes	28	39	0	Yes	29	35	0	Yes
R30	16	40	0	Yes	16	39	0	Yes	16	35	0	Yes
R31	29	40	0	Yes	29	39	0	Yes	30	35	0	Yes
R32	29	40	0	Yes	29	39	0	Yes	30	35	0	Yes
R33	17	40	0	Yes	17	39	0	Yes	18	35	0	Yes

(1) Predicted noise levels include a +5 dB penalty to account for tonal noise characteristics from the Project.

(2) Negligible exceedances of 1 to 2 dB have been considered to achieve compliance with the criteria as 1 to 2 dB exceedances would not be discernible by the average human ear.

(3) Predicted night-time operational noise level at receiver R01 still exceeds the night-time criterion after the implementation of the noise mitigation measures. Therefore, architectural treatment to this receiver has been recommended.

Appendix I – Operational Noise Contours with Noise Mitigation Options

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Appendix J – Draft Construction Noise and Vibration Management Plan

This Construction Noise and Vibration Management Plan (CNVMP) forms part of the Construction Environmental Management Plan for the project. This CNVMP has been prepared to address the construction noise and vibration requirements listed in the Development Consent.

Purpose

The purpose of this CNVMP is to describe how the contractor proposes to manage potential noise and vibration impacts during construction of the Project.

Objective

The key objective of the CNVMP is to ensure that project noise and vibration impacts on nearby sensitive receivers are minimised and within the scope permitted by the planning approval. This includes management procedures to appropriately respond to complaints from the community and stakeholders relating to noise and vibration.

To achieve this objective, the contractor will undertake the following:

- Ensure appropriate controls and procedures are implemented during construction activities to avoid or reduce noise and vibration impacts and potential adverse impacts to neighbouring sensitive receivers.
- Ensure reasonable and feasible mitigation measures are implemented with the aim of achieving the requirements in the Development Consent and the management levels detailed in this CNVMP in accordance with the NSW EPA's *Interim Construction Noise Guideline*.
- Ensure complaints from community and stakeholders are reduced.

Construction hours

Standard construction hours

Construction, including the delivery of materials to and from the site, may only be carried out between the following hours:

(a) between 7 am and 6 pm, Mondays to Fridays inclusive; and
(b) between 8 am and 1 pm, Saturdays
(c) No work may be carried out on Sundays or public holidays

Out of hours work

Activities may be undertaken outside of the hours if required:

(a) by the Police or a public authority for the delivery of vehicles, plant or materials; or
(b) in an emergency to avoid the loss of life, damage to property or to prevent environmental harm; or
(c) where the works are inaudible at the nearest sensitive receivers; or
(d) where a variation is approved in advance in writing by the Planning Secretary or his nominee if appropriate justification is provided for the works.

Notification of such activities must be given to affected residents before undertaking the activities or as soon as practical afterwards.

Noise and vibration management measures

This section outlines noise management measures that will be implemented as part of the construction works, including consultation and complaint handling procedures.

It may not be feasible to adopt all management measures at all times during construction, and identification of all reasonable and feasible mitigation methods will be conducted by the site supervisor and/or environmental representative on a regular basis during noisy works near sensitive land uses.

In relation to the implementation of mitigation measures, feasibility addresses engineering consideration regarding what is practical to build. Reasonableness relates to the application of judgment in arriving at a decision, taking into account the following factors:

- work hours
- noise reduction achieved
- number of people or other uses benefited
- cost of the measure
- delay to schedule and whether the measure will prolong exposure to noise
- community views
- pre-construction noise levels at receivers

While the management measures presented will not necessarily result in mitigating all noise impacts at all times, they are expected to reduce impacts to levels most stakeholders should find acceptable considering the anticipated benefits of the completed project as a whole.

The noise management measures presented in Table 20 will be implemented throughout the construction of the project where reasonable and feasible:

Table 20 Noise and vibration management measures

Subject	Reference	Management measures	Responsibility
Complaints	NV1	All potentially affected residences will be informed of the construction works including working hours to be adhered to, and the level and duration of noise to expect during construction at least five days and not more than 14 days prior to the noise event.	Site Construction & Environmental Compliance Officer
	NV2	All potentially affected residences will be kept informed of any significant changes to construction activities.	Site Construction & Environmental Compliance Officer
	NV3	Any complaints received related to noise or vibration will be dealt with.	Site Construction & Environmental Compliance Officer

Subject	Reference	Management measures	Responsibility
	NV4	All site personnel will be instructed during a general induction as to their responsibilities in minimising noise and adhering to the noise minimisation measures.	Site Construction & Environmental Compliance Officer
Timing	NV5	Works to be undertaken during Standard Construction Hours where possible.	Site Construction & Environmental Compliance Officer
	NV6	Ensure deliveries are within the standard hours of 7:00 am to 6:00 pm.	Site Construction & Environmental Compliance Officer / Site Foreman
Equipment	NV7	Equipment operators are to report any faulty equipment.	Site Foreman
	NV8	There will be no dropping of materials from heights, throwing of metal items, or slamming of doors.	All site personnel
	NV9	Any equipment not in use for extended periods during construction work will be switched off.	All site personnel
	NV9	All vehicles and equipment will be regularly serviced, as per manufactures instructions and maintained in proper working order.	Site Construction & Environmental Compliance Officer
	NV10	Simultaneous operation of noisy plant will be avoided wherever practicable.	Site Foreman
	NV11	Wherever practicable, noisy equipment will be: a) Positioned behind structures that act as barriers to identified receptors. b) Positioned at the greatest distance from identified receptors. c) Oriented to directed noise emissions away from identified receptors.	Site Construction & Environmental Compliance Officer
	NV12	“Quiet” practices will be employed wherever practicable when operating equipment. Examples of quiet practices include (but are not limited to) avoiding unnecessary revving of engines, preventing forklift tines or excavator buckets from impacting on the ground, minimising the use of horns and/or public address systems where possible.	Site Foreman
	NV13	Any noisy construction activities will be completed in the shortest time possible.	All site personnel
Site personnel management	NV14	The induction of site staff will include a reference to potential noise impacts and the identification of noise-sensitive land uses.	Site Construction & Environmental Compliance Officer

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Subject	Reference	Management measures	Responsibility
	NV15	'Toolbox talks' will include a reference to any noise management measures being implemented on site at the time.	Site Foreman

Training and awareness

All Project personnel, subcontractors, consultants, and visitors will receive inductions prior to commencing on site. Project induction and training will fall under the following categories:

- General project induction; and
- Visitor induction.

Information specific to construction noise and vibration will be included in the general project induction and will include:

- Relevant approval conditions;
- Relevant legislation;
- All relevant project specific and standard noise and vibration mitigation measures;
- Location of nearest sensitive receptors;
- Designated loading/unloading areas and procedures;
- Standard construction hours (including deliveries); and
- Environmental incident and complaint procedures.

All inductions will be recorded in the training register held by the Site Construction & Environmental Compliance Officer.

Non-conformances

Non-conformances will be dealt with and documented in accordance with the complaints management system provided with the project Construction Environmental Management Plan.

Complaints management

Any complaints received from the community regarding noise shall be addressed in accordance with the Complaints Handling Procedures provided in the project Construction Environmental Management Plan.

Monitoring and reporting

Where a complaint is unable to be resolved to the satisfaction of the complainant, noise monitoring shall be undertaken to determine the contribution of noise from construction activities at the complainant's premises.

The noise monitoring will be undertaken by competent personnel who have received training in environmental noise monitoring. The measurements will be conducted in accordance with the procedures outlines in Australian Standard

AS 1055 “Acoustics – Description and measurement of environmental noise” and the NSW Industrial Noise Policy (INP). The following points should be followed when conducting noise monitoring:

- A field calibration should be conducted before and after measurements;
- The sound level meter must be set to an A-weighting and Fast;
- The sound level meter sample period should be set to 15-minutes;
- The following descriptors should be measured as a minimum: LA1, LAeq and LA90; and
- Measurements should be conducted a minimum of three metres from the nearest façade and/or solid fence/wall. If it is not possible to do this, corrections for façade reflection should be applied to the measurement results.

The results of the noise monitoring shall quantify the contribution of noise from construction works at complainant premises and assist in determining what corrective actions, if any, are required to address the complaint.